

# PQIS 2011 ANNUAL REPORT

PETROLEUM QUALITY INFORMATION SYSTEM



JA1 JP5 JP8 F76 MGO TS1



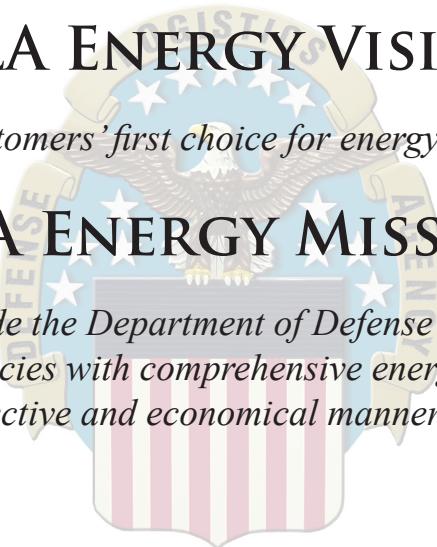
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# DLA ENERGY VISION

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*To provide the Department of Defense and other government agencies with comprehensive energy solutions in the most effective and economical manner possible.*





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## PETROLEUM QUALITY INFORMATION SYSTEM FUELS DATA (2011)

DLA Energy, is pleased to provide you with the 2011 edition of the "Petroleum Quality Information System (PQIS)." PQIS is an annual publication which is managed by the Quality / Technical Support office of DLA Energy. We are pleased to announce continued growth in the products which are featured in this publication. This year data is provided for the alternative fuel Hydrotreated Renewable F76; the lubricants: LTL, LO6, and LA6; the additive Fuel System Icing Inhibitor and an additional propellant purchased through our Aerospace Energy Program, RP2.

Analysis of the following products is continued from previous years:

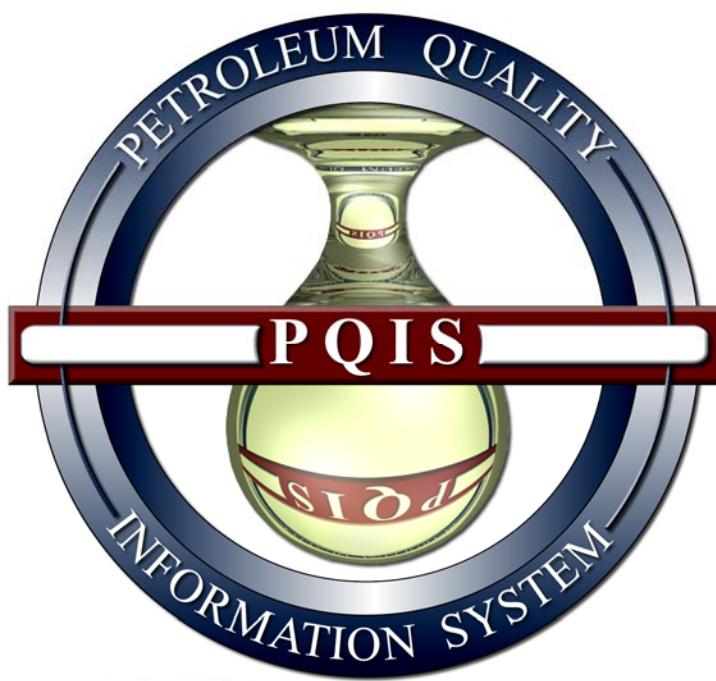
- Aviation Fuels: JAA, JA1, JP4, JP5, JP8, JPTS and TS1
- Marine Fuels: Fuel Naval Distillate (F76), Marine Gas Oil (MGO), Intermediate Fuel Oil (RME25)
- Propellants: High Density Synthetic Hydrocarbon (JP10), and Rocket Grade Kerosene (RP1)
- Alternative Fuels: Hydrotreated Renewable Jet (HRJ5 and HRJ8)

We would like to thank the Quality Assurance Representatives (QARs) of DLA Energy and the representatives from the suppliers under our DLA Energy Contracts who have worked with the PQIS Team to ensure complete representation of purchased product. The result is the only worldwide comprehensive data repository of test results for refined fuel, lubricant, and fuel additive properties.

In our continued effort to provide you with reliable, accurate information, we would appreciate any feedback noting updates or suggestions on improving this book. Please contact Mr. Douglas Martin at Commercial (703) 767-8382, e-mail [douglas.martin@dla.mil](mailto:douglas.martin@dla.mil), with any questions or to obtain additional copies of this report or the CD-ROM.

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# 2011 PQIS Report



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# Executive Summary



# Executive Summary

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# Executive Summary

## Quality/Technical Support Directorate (DLA Energy-Q)

DLA Energy-Q (comprising QT, QA, and QR) provides quality and technical support in the certification, quality assurance, and emerging research for supplying DLA Energy customers with fuel and energy-related products.



## Product Technology and Standardization Division (DLA Energy-QT)

DLA Energy-QT acts as the principal technical adviser to the Director of DLA Energy for technical matters on petroleum, missile fuels, coal, and related products and services. It maintains specification and measurement contract clauses and represents DLA Energy at industry standardization groups to ensure that product specification changes do not adversely impact end-user applications. The division reviews and approves all cataloging changes for both petroleum and aerospace energy products and serves as the lead standardization activity for petroleum products in the Department of Defense (DoD). QT provides technical support for the introduction of new supply lines such as alternative fuels and technical support to resolve problems in storage tanks, transportation, and handling systems caused by fuel chemistry. In addition, QT maintains the PQIS database.

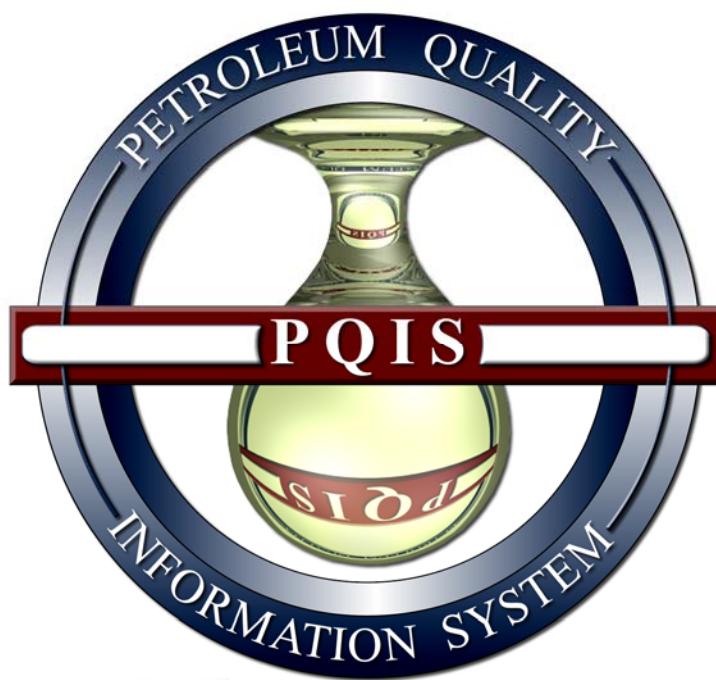
## Quality Operations Division (DLA Energy-QA)

DLA Energy-QA acts as the principal adviser and assistant to the Director for developing, monitoring, coordinating, publishing, and implementing quality policies and programs for DLA Energy-supplied commodities. It provides quality assurance (QA) and quality surveillance (QS) support to DoD and civilian agencies as defined in interservice support agreements and directives.

## Quality Research Division (DLA Energy-QR)

DLA Energy-QR is the research and development (R&D) arm of DLA Energy-Q, which seeks out R&D solutions for renewable energy initiatives as well as alternative and synthetic fuels to meet military service needs while reducing DoD's carbon footprint. These solutions help secure installation energy, reduce petroleum need and consumption, and deliver fuel more efficiently and economically.

# Executive Summary



# Introduction



# Introduction

## 2011 PQIS Report Information

### Terminology

**Spectender.** A complete specification analysis report of a product being offered for acceptance by the U.S. Government. It is the written report of results for full specification testing of a designated batch of product offered for acceptance.

**Batch Analysis.** Reflects one spectender series of test results (batch), regardless of how many shipments are made from the source tank or whether more than one tank is involved in a total loading or product movement.

**Volume.** For the purposes of this report, volume is expressed in millions of U.S. gallons, unless otherwise indicated.

**Region.** A grouping of states or countries into defined geographical areas, affording a more specific or focused data analysis for a particular area of interest. It is based on the U.S. Department of Energy–designated Petroleum Administration for Defense Districts (PADDs), cited here to provide a standard industry reference for comparative study. These do not correlate with the Defense Fuel Regions or Offices. Because shipments can originate and terminate in different regions, the determination of the region is based on the refinery location, rather than the receipt location.

**Mean.** The test result of each batch analysis added and divided by the number of batches. This average is based on occurrences of test values.

Example: Batch A, representing 1,000,000 U.S. gallons with a flash point of 46.0 °C, and Batch B, representing 500,000 U.S. gallons with a flash point of 43.5 °C.

Calculation:  $(46.0 + 43.5)/2 = \text{mean or average flash point of } 44.75 \text{ }^{\circ}\text{C}$ .

**Weighted Mean.** The volumetrically weighted average, based on volumes of product represented by test values.

Example: Batch A, representing 1,000,000 U.S. gallons with a flash point of 46.0 °C, and Batch B, representing 500,000 U.S. gallons with a flash point of 43.5 °C.

Calculation:  $[(46.0 \times 1,000,000) + (43.5 \times 500,000)]/1,500,000 = (67,750,000/1,500,000) = \text{weighted mean flash point of } 45.17 \text{ }^{\circ}\text{C}$ .

Note: Here, the two averaging methods differ by 0.42 °C. Each uses a different basis to calculate the average. Means are provided for each property characteristic for total product

procurements in this report. Weighted means are provided as well and are used for histograms and trends.

**NR.** Not reported or recorded. Used in charts to indicate no value was used in that instance.

**NP.** Not procured during the reporting period.

## Data Reporting

The data presented in this report have been carefully evaluated for accuracy and completeness. A CD-ROM, which includes abridged copies of PQIS databases stripped of sensitive material, is available to all users. The results of our analyses may have been affected by data in the unabridged version, so your analyses could produce slightly different results.

Although some reporting inconsistencies are inevitable, every effort has been made for complete accountability in collecting, analyzing, and presenting the data in this report. Data shortfalls range from inapplicability because of processing or the test methods employed to exemption in particular contracts or purchase orders. Logistical and data collection challenges also affect the process. The statistics presented are carefully selected and, where possible, weighted against volumetric validations.

Only analysis data from the associated spectender (batch) are used for the completed delivery amounts received during the calendar year. When data fall short or limited procurements reduce the volume of data available, only essential data are charted in summary tables for informational purposes. For instance, see the tables provided in the Product Data section.

In the larger fuel sections included in the report (JP8, JP5, etc.), source inputs tables specify the volume of fuel and the number of reports on which a fuel characteristic was analyzed. Tables show statistical summaries of minimum, maximum, average, and volumetrically weighted means for test results by properties. When applicable, statistical summaries for test properties are also segregated by geographic source of procurement. Histograms chart the distribution of 2011 test results to the volume of fuel, except for TS1, which bases the histograms on the count of batch analyses, since volumes were not recorded for this fuel.

Note: In histograms, the far left bar represents the percent volume of fuel associated with the minimum data value. Any other bar represents the percent volume of fuel greater than the data value of the bar to the immediate left of it and up to and including the value of that bar.

# Introduction

## Reporting Overview

### Defense Fuel Region and Petroleum Administration for Defense Districts

DoD has 12 regions in the reporting structure. Regions 1 through 5—designated as Petroleum Administration for Defense Districts (PADDs)—handle CONUS procurements (Figure 2-1). Regions 6 through 12 handle OCONUS procurements. Table 2-1 (page 9) lists all Defense Fuel Regions and their areas of responsibility, and Figure 2-2 (page 9) shows their locations worldwide. These regional designations are used throughout the report to identify the procurement source by geographic area and to outline CONUS and OCONUS bulk procurement acceptance responsibilities and PQIS activity processed by geographic location.

Table 2-2 (page 10) displays an 8-year breakdown by product grade by volume represented in the PQIS database. All bulk products are illustrated for 2011 by percentage of volume by fuel in Figure 2-3 (page 10). Volumes in Table 2-2 and volumes and percentages in Figure 2-3 do not represent what is procured by DLA Energy, but what is processed through the PQIS database through received test reports. Figures 2-4 and 2-5 (page 11) summarize the present and previous reporting year transportation methods used in support of the accepted procurements.

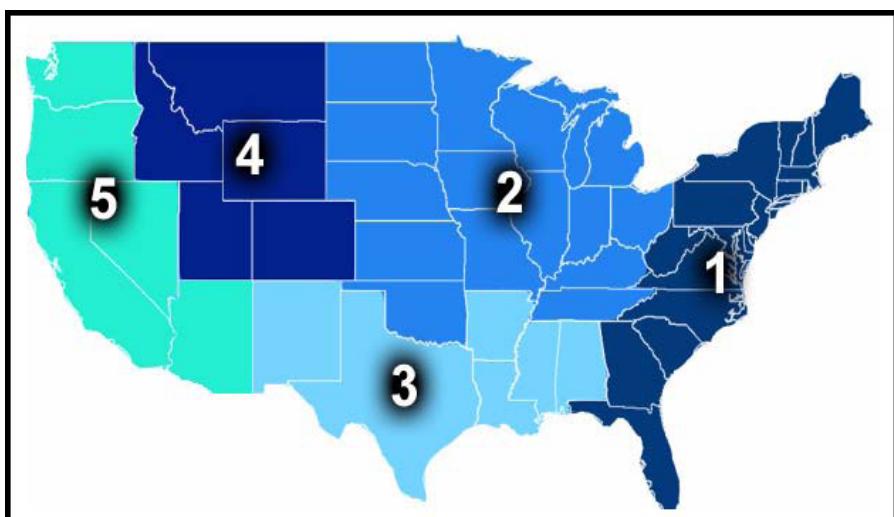


Figure 2-1: Petroleum Administration for Defense Districts

# Introduction

Region	Title	PADDS	State or Countries
1	East Coast	I	ME, VT, NH, MA, RI, CT, NY, PA, NJ, DE, MD, VA, WV, NC, SC, GA, FL
2	East Central	II	ND, SD, MN, IA, NE, WI, MI, OH, KY, TN, IN, IL, MO, KS, OK
3	Gulf Coast	III	AL, MS, AR, LA, TX, NM
4	West Central	IV	MT, ID, WY, UT, CO
5	West Coast	V	WA, OR, CA, NV, AZ
6	Middle East		Kuwait, Bahrain, Pakistan, United Arab Emirates
7	European		Europe, Israel, Turkey
8	Pacific		Korea, Japan, HI, AK, Australia, Russia, Singapore, China
9	Caribbean		Coastal Aruba, Bermuda, Bahamas, Barbados, British Virgin Islands, Cuba, Dominican Republic, Jamaica, Grand Cayman, Martinique, Puerto Rico, Virgin Islands
10	Central & South America		Belize, Columbia, Curacao, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru
11	Canada		Canada
12	Africa		Cape Verde, Ghana

Table 2-1: 12 Reporting Defense Regions and Areas of Responsibility



Figure 2-2: Map of the 12 Reporting Defense Regions

# Introduction

8-Year Breakdown by Product Grade by Volume (millions of gallons)								
Product	2004	2005	2006	2007	2008	2009	2010	2011
<b>AN8</b>	NR	3.52	3.60	NR	NR	NR	4.62	NP
<b>JA1</b>	133.18	178.63	233.15	326.32	339.20	506.55	302.96	467.90
<b>JAA</b>	NP	NP	NP	NP	NP	12.01	82.50	55.11
<b>JP4</b>	1.20	0.74	0.69	1.30	0.99	0.83	1.66	0.92
<b>JP5</b>	596.54	588.63	565.17	502.26	481.92	562.86	509.01	532.06
<b>JP8</b>	3,230.54	2,861.96	2,603.10	2,286.62	2,364.57	1,968.27	1,958.43	1,839.24
<b>JPTS</b>	2.28	3.32	1.41	3.89	4.46	3.52	1.92	14.78
<b>F76</b>	600.21	563.38	539.67	565.48	597.01	514.67	507.77	610.24
<b>RME</b>	14.20	11.94	NR	NR	NR	5.12	NR	6.05
<b>MGO</b>	NR	6.51	2.19	5.53	4.45	1.39	4.88	6.71
<b>Totals</b>	<b>4,578.15</b>	<b>4,218.63</b>	<b>3,948.98</b>	<b>3,691.40</b>	<b>3,792.59</b>	<b>3,575.23</b>	<b>3,373.74</b>	<b>3,533.01</b>

Table 2-2: 8-Year Breakdown by Product Grade by Volume Represented in PQIS (millions of gallons)

**Note:** Although JP10, RP1, RP2, and TS1 were procured in 2011, volumes were not reported for these fuels.

## Bulk Products Represented by Percent Volume Total 2011 U.S. Gallons—3,533,013,357

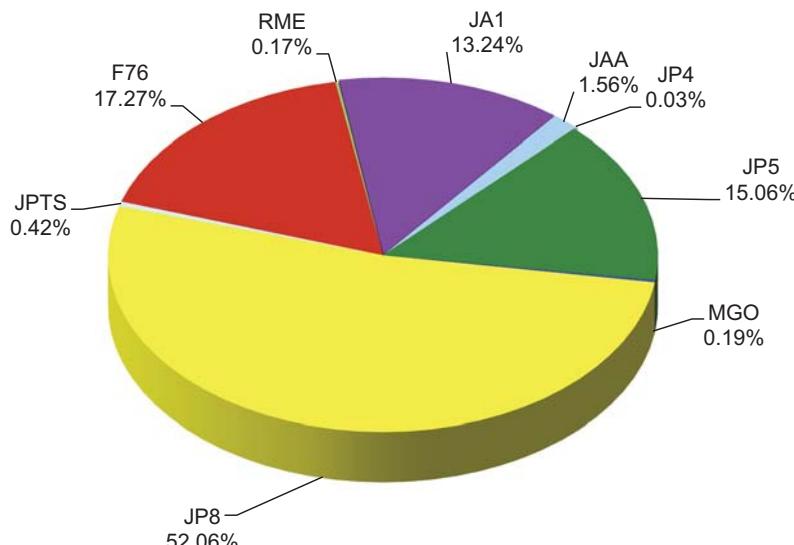


Figure 2-3: 2011 Percentage of Volume by Product Processed in PQIS

## 2011—Transportation Method by Percent Volume Total 3,526,301,297 U.S. Gallons

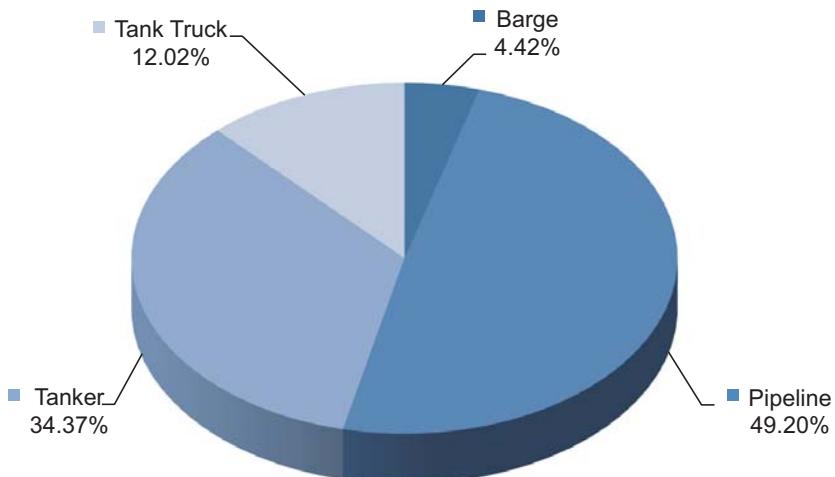


Figure 2-4: 2011 Transportation Mode by Percentage Volume

## 2010—Transportation Method by Percent Volume Total 3,368,865,082 U.S. Gallons

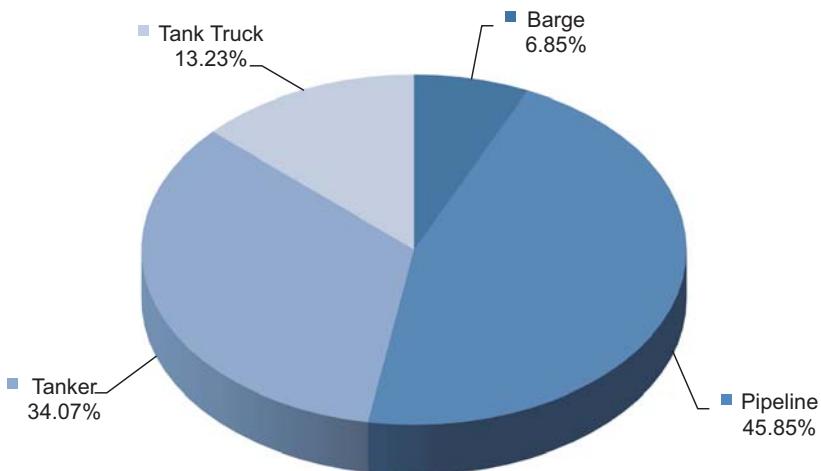


Figure 2-5: 2010 Transportation Mode by Percentage Volume

**Note:** Transportation modes are not captured for MGO in the PQIS database.  
MGO volume totals are not included in Figures 2-4 and 2-5.

# Introduction

## Summary by Region

Table 2-3 breaks down the number of analysis reports processed in the PQIS by product and individual region in 2011. Clause E40.05, Material Inspection and Receiving Report, cited in DLA Energy contracts, requires fuel contractors to submit a copy of the complete laboratory test report from each shipping tank used for shipments to DLA Energy customers. For many fuels in the product sections, source inputs tables detail the volume and number of reports used in calculating product test values. For products with limited batch reports and for region summary tables, only the total test results and volume for the product or region are provided. Analysis and volume totals are not provided for each fuel characteristic in these instances.

PQIS Batch Analysis Reports Processed by Region—2011													
Fuel	1	2	3	4	5	6	7	8	9	10	11	12	Total
AN8	—	—	—	—	—	—	—	—	—	—	—	—	0
JA1	—	—	—	—	—	25	222	1	—	—	—	—	248
JAA	10	14	32	—	105	—	—	—	—	—	—	—	161
JP4	—	—	—	—	—	—	36	—	—	—	—	—	36
JP5	—	14	95	—	79	10	20	20	—	—	—	—	238
JP8	9	321	625	94	194	88	56	157	—	—	—	—	1,544
JPTS	—	—	44	—	—	—	—	11	—	—	—	—	55
JP10	—	—	6	—	—	—	—	—	—	—	—	—	6
F76	—	—	21	—	23	11	18	37	—	—	—	—	110
MGO	57	30	3	—	15	—	—	25	15	38	1	—	185
PF1	—	—	—	—	—	—	—	—	—	—	—	—	0
RP1	—	—	5	—	—	—	—	—	—	—	—	—	5
RP2	—	—	6	—	—	—	—	—	—	—	—	—	6
TS1	—	—	—	—	—	—	95	—	—	—	—	—	95
<b>Totals</b>	<b>76</b>	<b>379</b>	<b>837</b>	<b>94</b>	<b>416</b>	<b>134</b>	<b>316</b>	<b>382</b>	<b>15</b>	<b>38</b>	<b>1</b>	<b>0</b>	<b>2,689</b>

Table 2-3: 2011 Breakdown of Total Number of Analysis Reports Processed in PQIS by Product and Region

12-Year Batch Analysis Reports Processed by Region													
Year	1	2	3	4	5	6	7	8	9	10	11	12	Totals
2000	143	400	1,023	225	337	25	127	258	22	—	—	—	2,560
2001	73	504	1,050	225	439	36	184	362	20	—	—	—	2,893
2002	113	411	1,025	193	464	95	193	290	18	—	—	—	2,802
2003	82	335	866	166	412	174	225	317	24	—	—	—	2,601
2004	6	486	1,121	152	525	195	229	296	14	—	—	—	3,024
2005	131	316	1,200	172	444	195	194	264	53	49	4	2	3,024
2006	18	301	1,111	147	436	261	122	415	43	11	1	—	2,866
2007	118	265	800	131	413	286	138	336	26	26	—	1	2,540
2008	77	315	934	130	426	292	180	327	41	23	2	4	2,751
2009	31	353	922	129	337	121	116	220	7	5	1	—	2,242
2010	52	344	918	134	363	106	117	433	35	50	3	3	2,558
2011	76	379	837	94	416	134	316	382	15	38	1	0	2,689

Table 2-4: 12-Year Batch Analysis Reports Processed by Region

Note: The region was not recorded for one MGO sample in 2011, but this sample is still included in the 2011 total number of samples in Tables 2-3 and 2-4.

The values in Table 2-4 represent the PQIS availability of possible spectender analysis reports for individual batches processed by region for calendar years 2000–2011.

Table 2-5 shows a 3-year history of volume by product by region processed in the PQIS.

Although JP10, RP1, RP2, and TS1 were procured in 2011, volumes were not reported for these fuels. For this reason, they are not included in Table 2-5. RME was procured, but no 2011 test results were reported in the PQIS database. AN8 and PF1 were not procured in 2011.

PQIS Annual Volume by Product by Region, 2009-2011 (millions of gallons)														
Year	Fuel	1	2	3	4	5	6	7	8	9	10	11	12	Totals
2009	AN8	—	—	—	—	—	—	—	—	—	—	—	—	NR
	JA1	—	—	—	—	—	148.18	274.23	—	—	—	—	—	422.42
	JAA	—	0.23	7.98	—	3.80	—	—	—	—	—	—	—	12.01
	JP4	—	—	—	—	—	—	—	0.83	—	—	—	—	0.83
	JP5	—	1.25	271.65	—	122.02	31.03	35.66	71.18	—	—	—	—	532.79
	JP8	9.49	203.82	822.48	63.48	330.46	186.13	89.29	255.69	—	—	—	—	1,960.85
	JPTS	—	—	3.52	—	—	—	—	—	—	—	—	—	3.52
	F76	—	—	103.48	—	81.03	105.48	80.61	102.18	15.84	—	—	—	488.63
	MGO	0.33	0.30	0.01	—	0.26	0.05	—	NR	0.10	0.27	0.01	—	1.33
2010	AN8	—	—	—	—	—	—	—	4.62	—	—	—	—	4.62
	JA1	—	—	—	—	—	66.59	196.50	51.86	—	—	—	—	314.95
	JAA	—	1.55	55.83	—	23.86	—	—	—	—	—	—	—	81.24
	JP4	—	—	—	—	—	—	—	1.58	—	—	—	—	1.58
	JP5	—	6.96	249.50	—	131.08	9.88	22.80	62.11	—	—	—	—	482.33
	JP8	13.72	197.21	739.44	69.04	290.91	185.54	166.43	265.76	—	—	—	—	1,928.05
	JPTS	—	—	1.77	—	—	—	—	NR	—	—	—	—	1.77
	F76	—	—	123.93	—	54.30	97.97	59.97	163.17	—	—	—	—	499.34
	MGO	0.55	0.40	0.02	—	0.39	—	—	1.11	0.50	1.46	0.06	0.08	4.58
2011	AN8	—	—	—	—	—	—	—	—	—	—	—	—	NP
	JA1	—	—	—	—	—	210.36	257.54	NR	—	—	—	—	467.90
	JAA	NR	3.09	18.49	—	33.63	—	—	—	—	—	—	—	55.20
	JP4	—	—	—	—	—	—	—	0.93	—	—	—	—	0.93
	JP5	—	0.48	235.85	—	99.90	73.87	62.38	56.64	—	—	—	—	529.12
	JP8	8.11	228.70	692.81	47.23	312.52	189.09	201.91	145.88	—	—	—	—	1,826.26
	JPTS	—	—	4.28	—	—	—	—	NR	—	—	—	—	4.28
	F76	—	—	100.16	—	83.86	65.14	111.10	238.20	—	—	—	—	598.46
	MGO	0.86	0.62	0.04	—	0.54	—	—	2.76	0.34	1.53	0.02	—	6.71

Table 2-5: Annual Volume of Fuel Processed by Product by Region in PQIS, 2009–2011 (millions of gallons)

Note: The region was not recorded for one MGO sample in 2011, but the volume for this sample is still included in the 2011 total volume for MGO in Table 2-5.

# Introduction





# Product Data

## Product Specifications

The following products are represented in PQIS:

- AN8.** MIL-DTL-83133 Clause Turbine Fuel, Aviation, AN8
- F76.** MIL-DTL-16884 Fuel, Naval Distillate (DFM/NATO Code F-76)
- FSII.** MIL-DTL-85470, Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745
- HRD76.** Hydrotreated Marine Diesel
- HRJ5.** Hydrotreated Renewable JP5
- HRJ8.** Hydrotreated Renewable JP8
- JA1.** Turbine Fuel, Aviation, Defence Standard 91-91
- JAA.** Jet A Turbine Fuel, Aviation, ASTM D 1655
- JP4.** MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP4, NATO Code F-40
- JP5.** MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5, NATO Code F-44
- JP8.** MIL-DTL-83133 Turbine Fuel, Aviation, JP8, NATO Code F-34
- JP10.** MIL-DTL-87107 Propellant, High Density Synthetic Hydro-carbon Type, Grade JP-10
- JPTS.** MIL-DTL-25524 (USAF) Turbine Fuel, Aviation, Thermally Stable
- LA6.** MIL-PRF-6081, Lubricating Oil, Jet Engine, Grade 1010
- LO6.** MIL-PRF-009000, Lubricating Oil, Shipboard Internal Combustion Engine, High-Output Diesel
- LTL.** MIL-PRF-17331, Lubricating Oil, Steam Turbine and Gear, Moderate Service
- MGO.** ISO-8217, Marine Gas Turbine, Grade DMA
- MUM.** ASTM D4814 Automotive Gasoline, Unleaded, Mid-Grade
- PF1.** MIL-DTL-87173 (USAF) Propellant, Priming Fluid, ALCM Engine, Grade PF-1
- RDF.** GOST 305-82, Russian Diesel Fuel
- RME25.** ISO 8217, Marine Residual Fuel, Grade RME-25
- RP1.** MIL-DTL-25576 Propellant, Rocket Grade Kerosene, Grade RP-1
- RP2.** MIL-DTL-25576 Propellant, Rocket Grade Kerosene, Grade RP-2

## **TS1.** GOST 10227-86, Russian Jet Fuel, Grade TC-1, first Category of Quality

The specifications for these products govern the compositions of the fuels procured for DoD. In most tables, this report summarizes only specification properties that have measurable and definitive requirements in the specification. Some exceptions include Cetane index (report) and water content for JP8.

The reporting of select values for properties and characteristics is included where data were recorded in PQIS, but not required by specification—for example, various distillation ranges. In most instances, specification properties that involve an assigned rating are not summarized. Data for properties not reported are available on request from DLA Energy-QT.

Various options may apply to product testing, and not all tests are performed on each batch equally for the purpose of data extraction and comparative analysis—for example, the net heat of combustion requirement. Contractors have an option of test methods or units of measurement for reporting. In the case of performing mercaptan sulfur testing, if the doctor test is negative, a mercaptan test need not be performed. Reporting of mercaptan sulfur results is not consistent with the number of batches. Many providers perform and report both results. In such instances, on the basis of these variables, the number of results selected from the total available analysis by batch may differ for individual test parameters for a given product.

Volume of fuel and the number of analyses used to determine each histogram are included in the source inputs table at the beginning of each product data section. Specification criteria are listed in all test results tables and histograms.

When limited procurements do not support a comprehensive review of a particular fuel, data are presented in a pair of tables, noting the region, volume of fuel, number of batch analyses, minimum value, maximum value, mean, and weighted mean. JAA, JP4, and JPTS are reported for 2011 in this manner. Data for propellants (JP10, RP1, and RP2), alternative fuels (HRJ5, HRJ8, and HRD76), lubricants (LTL, LO6, and LA6), and fuel system icing inhibitor (FSII) are summarized in a single table displaying the minimum value, maximum value, and mean for fuel characteristics. Weighted means are also provided for alternative fuels, lubricants, and FSII, as volumes were reported for these products.

# Product Data

## JAA—2011 Data Summary

Tables 3-1 and 3-2 display JAA results for the 2011 reporting period, during which Regions 1, 2, 3, and 5 processed JAA procurements. In 2011, 161 analyses were queried from the PQIS, representing 55.20 million U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

For JAA, when the smoke point result is below 25 mm, the product is acceptable so long as the naphthalene content is below 3.0 percent and the smoke point is equal to or greater than the

Jet A Turbine Fuel, Aviation, ASTM D 1655 (JAA)			
Property	2011 Source Inputs		
	Region	Volume	Analysis
<b>Total Acid Number:</b> (mg KOH/g)	All	52.05	157
<b>Aromatics:</b> (vol %)	All	45.96	157
<b>Sulfur Mercaptan:</b> (mass %)	All	NR	30
<b>Sulfur, Total:</b> (mass %)	All	52.05	159
<b>Distillation:</b>			
Initial Boiling Point (IBP), (°C)	All	NR	10
10% recovered, (°C)	All	52.05	159
50% recovered, (°C)	All	52.05	159
90% recovered, (°C)	All	52.05	159
Final Boiling Point (FBP), (°C)	All	52.05	159
Residue, (vol %)	All	52.05	159
Loss, (vol %)	All	52.05	159
<b>Flash Point:</b> (°C)	All	51.00	158
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	All	30.06	117
<b>Freezing Point:</b> (°C)	All	50.48	157
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)	All	52.05	159
<b>Net Heat of Combustion:</b> (MJ/kg)	All	52.05	159
<b>Smoke Point:</b> (mm)	All	52.05	159
<b>Naphthalene:</b> (vol%)	All	52.05	155
<b>Thermal Stability:</b>			
Change in pressure drop, (mm Hg @ 275 °C)	All	NR	25
Change in pressure drop, (mm Hg @ 260 °C)	All	52.05	134
<b>Existent Gum:</b> (mg/100 mL)	All	52.05	159
<b>Water Separation Characteristics:</b> (rating)	All	52.05	153

Table 3-1: Jet A Turbine Fuel, Aviation, ASTM D 1655 (JAA), 2011 Source Inputs (volume in millions of gallons)

# Product Data

minimum of 18 mm. All 2011 naphthalene values are below 3.0 percent, and all smoke point values are equal to or greater than 18 mm. Therefore, all smoke point values for 2011 are acceptable.

For JAA, the water separation characteristics rating is a minimum of 85 with no electrical conductivity additive and a minimum of 70 with an electrical conductivity additive.

Jet A Turbine Fuel, Aviation, ASTM D 1655 (JAA)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.10</b>	0.0010	0.0250	0.0060	0.0065
<b>Aromatics:</b> (vol %)		<b>25.0</b>	9.4	24.1	19.39	19.58
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.003</b>	0.0003	0.0030	0.0016	NR
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0000	0.1700	0.1081	0.1003
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	<b>Report</b>		148.3	158.2	153.6	NR
10% recovered, <sup>1</sup> (°C)	<b>205<sup>(185)</sup></b>		146.3	196.0	170.9	171.2
50% recovered, (°C)	<b>Report</b>		193.8	220.6	203.2	201.6
90% recovered, (°C)	<b>Report</b>		214.0	264.0	251.8	247.2
Final Boiling Point (FBP), <sup>1</sup> (°C)	<b>300<sup>(340)</sup></b>		229.0	287.2	276.5	271.0
Residue, (vol %)	<b>1.5</b>		0.5	1.5	1.13	1.15
Loss, (vol %)	<b>1.5</b>		0.0	1.5	0.80	0.76
<b>Flash Point:</b> (°C)	<b>38</b>		41.0	56.0	44.52	45.10
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.8031	0.8174	0.8124	0.8141
<b>Freezing Point:</b> (°C)		<b>-40</b>	-60.0	-41.0	-48.6	-50.4
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.500	6.900	4.307	4.219
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		42.925	44.223	43.159	43.119
<b>Smoke Point:</b> (mm)	<b>25.0</b>		18.0	26.0	21.17	20.95
<b>Naphthalene:</b> (vol%)		<b>3.0</b>	0.10	2.89	2.14	1.92
<b>Thermal Stability:</b>						
Change in pressure drop, (mm Hg @ 275 °C)			0.00	1.00	0.60	NR
Change in pressure drop, (mm Hg @ 260 °C)	<b>25</b>		0.00	23.00	0.27	0.21
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.00	5.00	1.21	1.15
<b>Water Separation Characteristics:</b> (rating)	<b>70</b>		71	100	97.6	98.2

Table 3-2: Jet A Turbine Fuel, Aviation, ASTM D 1655 (JAA), 2011 Test Results

**Note 1:** Test method D2887 limits in parentheses (°C).

# Product Data

## JP4—2011 Data Summary

Tables 3-3 and 3-4 display JP4 results for the 2011 reporting period, during which only Region 8 processed JP4 procurements. Thirty-six analyses were queried from the PQIS, representing 0.93 million U.S. gallons. Two test results were below the minimum specification limit for “Distillation, 50% Recovered.” A waiver was granted allowing JP4 to be produced to an older

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP4 (NATO F-40)			
Property	2011 Source Inputs		
	Region	Volume	Analysis
<b>Total Acid Number:</b> (mg KOH/g)	8	0.93	36
<b>Aromatics:</b> (vol %)	8	0.93	36
<b>Sulfur, Mercaptan:</b> (mass %)	8	0.93	36
<b>Sulfur, Total:</b> (mass %)	8	0.93	36
<b>Distillation:</b>			
Initial Boiling Point (IBP) (°C)	8	0.93	36
10% recovered, (°C)	8	0.93	36
20% recovered, (°C)	8	0.93	36
50% recovered, (°C)	8	0.93	36
90% recovered, (°C)	8	0.93	36
End Point, (°C)	8	0.93	36
Residue, (vol %)	8	0.93	36
Loss, (vol %)	8	0.93	36
<b>Density:</b> (API @ 60 °F)	8	0.93	36
<b>Vapor Pressure:</b> (kPa @ 37.8°C)	8	0.88	34
<b>Freezing Point:</b> (°C)	8	0.93	36
<b>Heating Value, Heat of Combustion:</b> (MJ/kg)	8	0.93	36
<b>Hydrogen Content:</b> (mass %)	8	0.93	36
<b>Smoke Point:</b> (mm)	8	NR	NR
<b>Thermal Stability:</b>			
Change in pressure drop, (mm Hg @ 275 °C)	8	0.66	26
Change in pressure drop, (mm Hg @ 260 °C)	8	0.27	10
<b>Existent Gum:</b> (mg/100 mL)	8	0.93	36
<b>Particulate Matter:</b> (mg/L)	8	0.93	36
<b>Filtration Time:</b> (minutes)	8	0.93	36
<b>MSEP:</b> (rating)	8	0.93	36
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	8	0.93	36

Table 3-3: MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP4 (NATO F-40), 2011 Source Inputs (volume in millions of gallons)

# Product Data

version of the specification, and all values were within the limits allowed by the waiver.

The specification criterion listed for Micro Separometer (MSEP) is presented as the lowest acceptable by specification. The threshold lower limit on MSEP ratings varies from 70 to 90 on the basis of additives and additive combinations.

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP4 (NATO F-40)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.004	0.011	0.007	0.007
<b>Aromatics:</b> (vol %)		<b>25.0</b>	11.2	17.6	14.88	14.58
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	0.0003	0.0008	0.0005	0.0005
<b>Sulfur, Total:</b> (mass %)		<b>0.40</b>	0.008	0.018	0.014	0.014
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)		<b>Report</b>	30.2	57.9	51.5	50.9
10% recovered, (°C)		<b>Report</b>	110.5	115.7	113.5	113.6
20% recovered, (°C)	<b>100</b>		115.4	120.7	118.7	118.7
50% recovered, (°C)	<b>125</b>		124.1	130.0	127.5	127.6
90% recovered, (°C)		<b>Report</b>	142.0	148.1	145.1	145.4
End Point, (°C)		<b>270</b>	173.5	214.5	192.2	195.3
Residue, (vol %)		<b>1.5</b>	0.7	1.5	1.26	1.28
Loss, (vol %)		<b>1.5</b>	0.5	1.5	1.24	1.26
<b>Density:</b> (API @ 60 °F)	<b>45.0</b>	<b>57.0</b>	52.6	53.5	52.91	52.91
<b>Vapor Pressure:</b> (kPa @ 37.8°C)	<b>14</b>	<b>21</b>	15.9	18.3	17.1	17.1
<b>Freezing Point:</b> (°C)		<b>-58</b>	-76.3	-58.0	-59.5	-59.0
<b>Heating Value, Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.2	43.4	43.27	43.29
<b>Hydrogen Content:</b> (mass %)	<b>13.5</b>		15.40	15.80	15.56	15.57
<b>Smoke Point:</b> (mm)	<b>20.0</b>		NR	NR	NR	NR
<b>Thermal Stability:</b>						
Change in pressure drop, (mm Hg @ 275 °C)		<b>25</b>	0.00	1.00	0.36	0.29
Change in pressure drop, (mm Hg @ 260 °C)			0.00	1.00	0.38	0.20
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	1.00	3.00	1.08	1.09
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.18	0.92	0.43	0.45
<b>Filtration Time:</b> (minutes)		<b>10</b>	3	4	3.06	3.06
<b>MSEP:</b> (rating)	<b>70</b>		93	99	97.3	97.2
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.11	0.15	0.137	0.136

Table 3-4: MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP4 (NATO F-40), 2011 Test Results

# Product Data

## JPTS—2011 Data Summary

Tables 3-5 and 3-6 display JPTS results for the 2011 reporting period. Fifty-five analyses were queried from the PQIS, representing 4.28 million U.S. gallons. Regions 3 and 8 processed JPTS procurements for this reporting period, but volumes were only recorded for Region 3. Aside from one particulate matter measurement that exceeded the maximum specification limit, all batches met specification requirements for all fuel properties

MIL-DTL-25524 (USAF) Turbine Fuel, Aviation, Thermally Stable			
Property	2011 Source Inputs		
	Region	Volume	Analysis
<b>Total Acid Number:</b> (mg KOH/g)	All	4.28	53
<b>Aromatics:</b> (vol %)	All	4.28	53
<b>Sulfur, Mercaptan:</b> (mass %)	All	NR	NR
<b>Sulfur, Total:</b> (mass %)	All	4.28	53
<b>Distillation:</b>			
Initial Boiling Point (IBP) (°C)	All	4.28	53
10% recovered, (°C)	All	4.28	53
50% recovered, (°C)	All	4.28	53
90% recovered, (°C)	All	4.28	53
End Point, (°C)	All	4.28	53
Residue, (vol %)	All	4.28	53
Loss, (vol %)	All	4.18	52
<b>Flash Point:</b> (°C)	All	4.28	53
<b>Density:</b> (API @ 60 °F)	All	4.28	53
<b>Freezing Point:</b> (°C)	All	4.28	53
<b>Viscosity:</b> (cSt @ -40 °C)	All	4.28	53
<b>Net Heat of Combustion:</b> (BTU/lb)	All	4.28	53
<b>Hydrogen Content:</b> (mass %)	All	4.28	53
<b>Smoke Point:</b> (mm)	All	4.28	53
<b>Thermal Stability:</b>			
Change in pressure drop, (mm Hg @ 335 °C)	All	NR	11
<b>Existent Gum:</b> (mg/100 mL)	All	4.28	53
<b>Particulate Matter:</b> (mg/L)	All	4.16	52
<b>Water Separation Characteristics:</b> (rating)	All	4.28	53

Table 3-5: MIL-DTL-25524 (USAF) Turbine Fuel, Aviation, JPTS, 2011 Source Inputs (volume in millions of gallons)

# Product Data

measured in 2011. For JPTS, a hydrogen content minimum of 14.00 or a smoke point minimum of 25 mm is acceptable. The sulfur, mercaptan limit or a negative doctor test result is acceptable to meet the specification requirement. For distillation values, test method D2887 limits are in parentheses under the specification limits columns in Table 3-6.

MIL-DTL-25524 (USAF) Turbine Fuel, Aviation, Thermally Stable						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0024	0.0140	0.0070	0.0080
<b>Aromatics:</b> (vol %)	<b>5.0</b>	<b>20.0</b>	10.4	14.4	12.31	12.31
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.001</b>	NR	NR	NR	NR
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0001	0.0050	0.0028	0.0034
<b>Distillation</b> (D2887 limits in parentheses):						
Initial Boiling Point (IBP), <sup>1</sup> (°C)	157 <sup>(105)</sup>		157.0	170.0	162.3	163.1
10% recovered, <sup>1</sup> (°C)		193 <sup>(174)</sup>	163.7	179.0	170.2	171.6
50% recovered, <sup>1</sup> (°C)		204 <sup>(207)</sup>	169.7	190.0	182.2	185.0
90% recovered, <sup>1</sup> (°C)		238 <sup>(250)</sup>	196.9	226.0	216.4	220.0
End Point, <sup>1</sup> (°C)		260 <sup>(288)</sup>	220.4	260.0	237.6	241.1
Residue, (vol %)		1.5	0.8	1.5	1.20	1.22
Loss, (vol %)		1.5	0.0	1.5	0.62	0.59
<b>Flash Point:</b> (°C)	<b>43</b>		45.0	124.0	51.51	54.18
<b>Density:</b> (API @ 60 °F)	<b>46.0</b>	<b>53.0</b>	46.7	51.3	49.4	50.0
<b>Freezing Point:</b> (°C)		-53	-75.5	-54.5	-60.6	-57.8
<b>Viscosity:</b> (cSt @ -40 °C)		<b>12.0</b>	3.50	7.40	5.35	5.53
<b>Net Heat of Combustion:</b> (BTU/lb)	<b>18,400</b>		18,632	18,812	18,708	18,728
<b>Hydrogen Content:</b> (mass %)	<b>14.00</b>		14.00	14.76	14.27	14.34
<b>Smoke Point:</b> (mm)	<b>25.0</b>		26.0	29.0	26.68	26.87
<b>Thermal Stability:</b>						
Change in pressure drop, (mm Hg @ 335°C)		<b>25</b>	0.00	1.00	0.55	NR
<b>Existent Gum:</b> (mg/100 mL)		<b>5.0</b>	0.20	2.40	0.64	0.57
<b>Particulate Matter:</b> (mg/L)		<b>0.3</b>	0.03	0.57	0.14	0.11
<b>Water Separation Characteristics:</b> (rating)	<b>Report</b>		59	100	81.7	83.3

Table 3-6: MIL-DTL-25524 (USAF) Turbine Fuel, Aviation, JPTS, 2011 Test Results

**Note 1:** Test method D2887 limits in parentheses (°C).

# Product Data

## JP10—2011 Data Summary

Table 3-7 displays JP10 results for the 2011 reporting period, during which only Region 3 processed JP10 procurements. Six analyses were queried from the PQIS, but volumes were not recorded. All batches met specification requirements for all fuel properties measured in 2011.

MIL-DTL-87107, Propellant, High Density Synthetic Hydrocarbon Type, Grade JP-10					
Property	Specification Limits		2011 Test Results		
	Min	Max	Min	Max	Mean
<b>Color, Saybolt:</b>	25		30	30	30
<b>Chemical Analysis:</b>					
Exotetraydrodi (cyclopentadiene): (wt %)	98.5	100.0	99.4	99.6	99.48
Other Hydrocarbons: (wt %)		1.5	0.4	0.6	0.52
<b>Flash point: (°C)</b>	54.4		56.00	60.00	57.00
<b>Density: (kg/L @ 15 °C)</b>	0.935	0.943	0.940	0.940	0.940
<b>Freezing Point: (°C)</b>		-79	-80.0	-80.0	-80.0
<b>Viscosity:</b>					
cSt @ -54 °C		40	24.00	32.00	28.00
cSt @ -18 °C		10	7.00	8.00	7.33
<b>Net Heat of Combustion:</b>					
MJ/kg	42.1		42.1	42.3	42.23
MJ/m	39,400		NR	NR	NR
<b>Thermal stability:</b>					
Change in pressure drop, (mm Hg @ 300 °C)		10	0.0	0.0	0.0
Heater tube deposit visual rating		< code 3	1	1	1
<b>Existent Gum: (mg/100 mL)</b>		5.0	1.0	1.0	1.0
<b>Particulate matter: (mg/L)</b>		1.0	0.0	0.1	0.05

Table 3-7: MIL-DTL-87107, Propellant, High Density Synthetic Hydrocarbon Type, Grade JP-10, 2011 Test Results

## RP1—2011 Data Summary

Table 3-8 displays RP1 results for the 2011 reporting period, during which only Region 3 processed RP1 procurements. Five analyses were queried from the PQIS, but volumes were not recorded. All batches met specification requirements for all fuel properties measured in 2011.

MIL-DTL-25576, Propellant, Rocket Grade Kerosene, Grade RP-1					
Property	Specification Limits		2011 Test Results		
	Min	Max	Min	Max	Mean
<b>Aromatics:</b> (vol %)		<b>5.0</b>	5.0	5.0	5.0
<b>Mercaptan-sulfur:</b> (mg/kg)		<b>3</b>	0.0003	0.0003	0.0003
<b>Sulfur, Total:</b> (mg/kg)		<b>30</b>	0.0001	5.4000	1.0801
<b>Specific Gravity:</b> (kg/L @ 15 °C)	<b>0.799</b>	<b>0.815</b>	0.800	0.812	0.805
<b>Distillation:</b>					
Initial Boiling Point (IBP) (°F)	<b>Report</b>		355.0	365.0	359.4
Fuel Evaporated, 10%, (°F)	<b>365</b>	<b>410</b>	381.0	386.0	384.0
Fuel Evaporated, 50%, (°F)	<b>Report</b>		412.0	413.0	412.8
Fuel Evaporated, 90%, (°F)	<b>Report</b>		461.0	466.0	464.0
End Point, (°F)		<b>525</b>	497.0	504.0	499.4
Residue, (vol %)		<b>1.5</b>	0.6	1.2	1.1
Loss, (vol %)		<b>1.5</b>	0.1	0.9	0.4
<b>Flash Point:</b> (°F)	<b>140</b>		143.0	160.0	152.6
<b>Hydrogen Content:</b> (mass %)	<b>13.8</b>		14.13	14.30	14.22
<b>Freezing Point:</b> (°F)		<b>-60</b>	-112.0	-73.0	-89.8
<b>Viscosity:</b> (cSt @ -30 °F)		<b>16.5</b>	9.00	10.00	9.58
<b>Thermal Value, Net Heat of Combustion:</b> (BTU/lb)	<b>18,500</b>		18,652	18,846	18,710
<b>Particulate:</b> (mg/L)		<b>1.0</b>	0.03	1.00	0.25
<b>Olefins:</b> (vol %)		<b>2.0</b>	0.30	1.20	0.74
<b>Existent Gum:</b> (mg/100 mL)		<b>1</b>	1.00	1.00	1.00
<b>Copper Strip Corrosion</b>		<b>1</b>	1	1	1

Table 3-8: MIL-DTL-25576, Propellant, Rocket Grade Kerosene, Grade RP-1, 2011 Test Results

# Product Data

## RP2—2011 Data Summary

Table 3-9 displays RP2 results for the 2011 reporting period, during which only Region 3 processed RP2 procurements. Six analyses were queried from the PQIS, but volumes were not recorded. All batches met specification requirements for all fuel properties measured in 2011.

MIL-DTL-25576, Propellant, Rocket Grade Kerosene, Grade RP-2					
Property	Specification Limits		2011 Test Results		
	Min	Max	Min	Max	Mean
<b>Aromatics:</b> (vol %)		<b>5.0</b>	5.0	5.0	5.0
<b>Sulfur, Total:</b> (mg/kg)		<b>0.1</b>	0.0200	0.0800	0.0400
<b>Distillation:</b>					
Initial Boiling Point (IBP) (°F)		<b>Report</b>	352.0	388.0	365.3
Fuel Evaporated, 10%, (°F)	365	<b>410</b>	378.0	408.0	385.5
Fuel Evaporated, 50%, (°F)		<b>Report</b>	411.0	436.0	421.3
Fuel Evaporated, 90%, (°F)		<b>Report</b>	466.0	490.0	475.3
End Point, (°F)		<b>525</b>	497.0	518.0	506.0
Residue, (vol %)		<b>1.5</b>	1.1	1.4	1.2
Loss, (vol %)		<b>1.5</b>	0.0	0.8	0.4
<b>Flash Point:</b> (°F)	<b>140</b>		144.0	165.0	155.0
<b>Specific Gravity:</b> (kg/L @ 15 °C)	<b>0.799</b>	<b>0.815</b>	0.800	0.800	0.800
<b>Hydrogen Content:</b> (mass %)	<b>13.8</b>		14.21	14.40	14.29
<b>Freezing Point:</b> (°F)		<b>-60</b>	-81.0	-60.0	-75.7
<b>Viscosity:</b> (cSt @ -30 °F)		<b>16.5</b>	10.30	12.80	11.62
<b>Thermal Stability:</b>					
Change in pressure drop in 5 hours, mm Hg @ 260 °C		<b>Report</b>	0.00	7.00	3.33
Delta Tube Deposit Rater (TDR) Spun		<b>Report</b>	5.80	68.00	45.27
<b>Thermal Value, Net Heat of Combustion:</b> (BTU/lb)	<b>18,500</b>		18,660	18,709	18,681
<b>Particulate:</b> (mg/L)		<b>1.0</b>	0.10	0.20	0.13
<b>Olefins:</b> (vol %)		<b>2.0</b>	0.30	1.00	0.60
<b>Existent Gum:</b> (mg/100 mL)		<b>1</b>	1.00	1.00	1.00
<b>Copper Strip Corrosion</b>		<b>1</b>	1	1	1

Table 3-9: MIL-DTL-25576, Propellant, Rocket Grade Kerosene, Grade RP-2, 2011 Test Results

## HRJ5—2011 Data Summary

Table 3-10 displays Hydrotreated Renewable JP5 (HRJ5) results for the 2011 reporting period. Thirteen analyses were queried from the PQIS, representing 76.35 thousand U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

Hydrotreated Renewable Jet (HRJ5) for Navy						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.004	0.005	0.0048	0.0047
<b>Sulfur Content:</b> (ppm)		<b>15</b>	0.050	0.080	0.068	0.067
<b>Distillation:</b>						
Initial Boiling Point (IBP), (°C)		Report	172.5	177.0	174.0	174.1
10% (T10), (°C)		205	190.5	193.0	191.1	191.1
50% (T50), (°C)		Report	236.0	240.5	239.2	239.0
90% (T90), (°C)		Report	272.0	274.5	273.7	273.7
Final boiling point (FBP), (°C)		300	281.0	285.5	282.6	282.7
Residue, (vol %)		1.5	1.0	1.2	1.0	1.1
Loss, (vol %)		1.5	0.5	1.0	0.8	0.8
T90-T10, (°C)		25	79.0	84.0	82.6	82.5
<b>Flash Point:</b> (°C)		60	62.0	64.0	62.9	62.9
<b>Density:</b> (kg/L @ 15 °C)	<b>0.760</b>	<b>0.845</b>	0.7654	0.7680	0.7668	0.7669
<b>Freezing Point:</b> (°C)		-46	-53.0	-50.5	-51.8	-51.8
<b>Kinematic Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	7.996	8.258	8.168	8.164
<b>Heating Value:</b> (MJ/kg)	<b>42.6</b>		43.991	44.087	44.032	44.033
<b>Cetane Number:</b> (calculated)	<b>40</b>		60.0	63.5	61.7	61.7
<b>Total Water:</b> (ppm)		75	21	32	28.6	28.3
<b>Nitrogen Content:</b> (ppm)		<b>10</b>	0.300	0.480	0.370	0.370
<b>Thermal Stability:</b>						
Pressure Difference, mm Hg @ 280 °C		25	0.00	0.00	0.00	0.00
<b>Metals:</b> (ppm)		<b>0.5</b>	0.01	0.01	0.01	0.01
<b>Alkali Metals and Metalloids:</b> (ppm)		<b>1.0</b>	0.01	0.02	0.01	0.01
<b>Hydrocarbon Composition:</b>						
Paraffins (normal and iso), (mass %)	Balance		95.0	95.0	95.00	95.00
Cyclo Paraffins, (mass %)		<b>15.0</b>	5.0	5.0	5.00	5.00
Total Aromatics, (mass %)		<b>0.5</b>	0.2	0.3	0.23	0.23
<b>Particulate:</b> (mg/L)		<b>1.0</b>	0.15	0.74	0.533	0.515
<b>Filtration Time:</b> (minutes)		<b>15</b>	5	7	5.62	5.67
<b>MSEP:</b> (rating)		<b>85</b>	95	98	96.4	96.4

Table 3-10: Hydrotreated Renewable JP5, 2011 Test Results

# Product Data

## HRJ8—2011 Data Summary

Table 3-11 displays Hydrotreated Renewable JP8 (HRJ8) results for the 2011 reporting period. Nine analyses were queried from the PQIS, representing 48.87 thousand U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

Hydrotreated Renewable JP8 (HRJ8)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Acidity, Total:</b> (mg KOH/g)		<b>0.015</b>	0.001	0.002	0.0016	0.0016
<b>Sulfur:</b> (mg/kg)		<b>15</b>	0.050	0.150	0.094	0.101
<b>Distillation:</b>						
10% recovered (T10), (°C)		<b>205</b>	157.0	169.0	164.4	165.0
50% recovered (T50), (°C)		<b>Report</b>	214.5	227.5	218.6	217.6
90% recovered (T90), (°C)		<b>Report</b>	259.0	273.5	266.2	265.1
Final boiling point, (°C)		<b>300</b>	269.0	280.0	276.6	276.0
T90-T10, (°C)	<b>22</b>		92.0	111.5	101.2	99.7
Residue, (%)		<b>1.5</b>	0.8	1.3	1.1	1.0
Loss, (%)		<b>1.5</b>	0.3	0.7	0.7	0.6
<b>Flash Point:</b> (°C)	<b>38</b>	<b>68</b>	40.0	46.0	43.1	43.2
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	<b>751</b>	<b>840</b>	757.4	761.5	758.6	758.3
<b>Freezing Point:</b> (°C)		<b>-47</b>	-55.0	-53.0	-54.1	-54.2
<b>Viscosity:</b>						
mm <sup>2</sup> /s @ -20 °C		<b>8.0</b>	5.106	5.908	5.328	5.265
mm <sup>2</sup> /s @ 40 °C		<b>Report</b>	1.397	1.525	1.431	1.420
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.312	43.829	43.526	43.486
<b>Cetane Number:</b> (calculated)	<b>40</b>		57.3	59.9	58.3	58.4
<b>Water:</b> (mg/kg)		<b>75</b>	17	35	23.9	23.2
<b>Nitrogen:</b> (mg/kg)		<b>5</b>	0.110	0.380	0.232	0.210
<b>Thermal Stability:</b>						
Filter pressure drop, mm Hg @ 280 °C		<b>25</b>	0.00	0.00	0.00	0.00
<b>Metals:</b> (mg/kg)		<b>0.1</b>	0.01	0.05	0.02	0.02
<b>Glass Metals:</b> (mg/kg)		<b>Report</b>	0.02	0.04	0.03	0.03
<b>Hydrocarbon Composition:</b>						
Cycloparaffins, (mass %)		<b>15</b>	1.0	6.0	3.00	2.91
Aromatics, (mass %)		<b>0.5</b>	0.3	0.3	0.30	0.30
Paraffins, (mass %)		<b>Balance</b>	94.0	99.0	97.00	97.09
Carbon and Hydrogen, (mass %)	<b>&gt;99.0</b>		99.5	100.0	99.92	99.97
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.01	0.13	0.086	0.093
<b>Filtration Time:</b> (minutes)		<b>15</b>	4	7	5.89	6.15
<b>Water Separation Index w/out SDA:</b> (rating)	<b>85</b>		100	100	100.0	100.0

Table 3-11: Hydrotreated Renewable JP8 (HRJ8), 2011 Test Results

## HRD76—2011 Data Summary

Table 3-12 displays Hydrotreated Renewable Marine Diesel (HRD76) results for the 2011 reporting period. Seventeen analyses were queried from the PQIS, representing 101.65 thousand U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

Hydroprocessed Renewable Marine Diesel (HRD76)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
Flash Point: (°C)	60		68.5	78.0	71.5	71.7
Density: (kg/L @ 15 °C)	0.774	0.876	0.7758	0.7815	0.7777	0.7775
Total Water: (ppm)	200		26.0	38.0	29.6	29.8
Particulate: (mg/L)	1.0		0.10	0.90	0.34	0.34
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	1.7	4.3	2.711	2.897	2.802	2.798
Cetane Number: (calculated)	42	80	74.7	74.7	74.7	74.7
<b>Distillation</b>						
Initial Boiling Point (IBP), (°C)	Report		167.5	187.0	175.1	175.2
10% (T10), (°C)	191	290	233.0	255.0	245.1	244.7
50% (T50), (°C)	Report		279.5	281.5	280.3	280.3
90% (T90), (°C)	290	357	291.5	293.5	292.1	292.1
Final boiling point (FBP), (°C)	300	385	305.0	308.5	306.9	306.9
Residue + Loss, (vol %)	3.0		2.0	2.0	2.0	2.0
T50-T10, (°C)	Report		26.5	46.5	35.2	35.5
T90-T10, (°C)	20		38.5	58.5	47.0	47.4
Heating Value: (MJ/kg)	43.0		43.665	43.992	43.819	43.812
MSEP Diesel Cap:	85		89	97	93.7	93.9
Acid Number: (mg KOH/g)	0.08		0.010	0.010	0.010	0.010
Antioxidant: (ppm)	17.2	24.0	20.0	20.0	20.0	20.0
Sulfur Content: (ppm)	15		0.050	0.050	0.050	0.050
Nitrogen Content: (ppm)	10		0.100	0.200	0.124	0.125
Metals: (ppm)	0.5 total		0.01	0.10	0.02	0.02
Alkali Metals and Metalloids: (ppm)	1 total		0.03	0.15	0.09	0.08

Table 3-12: Hydrotreated Renewable Marine Diesel (HRD76), 2011 Test Results

# Product Data

## LTL—2011 Data Summary

Table 3-13 displays LTL results for the 2011 reporting period. One hundred seven analyses were queried from the PQIS, representing 585.36 thousand U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

For foaming sequences, individual batch results can be viewed in the database on the CD.

MIL-PRF-17331, Lubricating Oil, Steam Turbine and Gear, Moderate Service						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
Sulfur: (%)	Report		0.000	0.480	0.019	0.009
Acid Number: (mg KOH/g oil)		0.3	0.100	0.300	0.284	0.286
Corrosion (in presence of salt water)	None		None	None	None	None
Copper Strip Corrosion Test @ 100 °C: (appearance)		1	1	1	1	1
Water: (%)	None		0.00	0.00	0.00	0.00
Gravity: (API)	Report		28.80	32.10	31.22	31.24
Flash Point: (°C)	204		252.0	280.0	266.4	266.8
Pour Point: (°C)		-6	-72.0	-6.0	-26.4	-27.0
Viscosity:						
Centistokes @ 4.4 °C		870	762.0	814.4	780.4	780.3
Centistokes @ 100 °C	8.0		9.275	10.320	9.844	9.832
Oxidation by rotating bomb:	Report		240.0	634.0	286.6	278.2
Cleanliness: (mg/100 mL)		4.0	0.00	1.30	0.09	0.07

Table 3-13: MIL-PRF-17331, Lubricating Oil, Steam Turbine and Gear, Moderate Service (LTL), 2011 Test Results

## LO6—2011 Data Summary

Table 3-14 displays LO6 results for the 2011 reporting period. Twenty-five analyses were queried from the PQIS, representing 144.39 thousand U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

For foaming sequences, individual batch results can be viewed in the database on the CD.

MIL-PRF-009000, Lubricating Oil, Shipboard Internal Combustion Engine, High-Output Diesel						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
Ash, sulfated: (%)	Report		0.000	1.950	0.581	0.567
Copper Strip Corrosion Test @ 100 °C: (appearance)		1b	1	1	1	1
Flash Point: (°C)	225		240.0	274.0	254.5	254.2
Gravity: (degree API)	Report		27.10	29.70	28.49	28.51
Pour Point: (°C)		-12	-39.0	-15.0	-25.6	-25.7
Sulfur:	Report		0.000	0.250	0.075	0.074
Total Base Number: (mg KOH/g)	12		12.58	15.80	14.16	14.19
Viscosity Index:	90		100.0	112.0	104.4	104.4
Viscosity: (cSt @ 100 °C)	12.5	16.3	12.59	13.40	12.93	12.93

Table 3-14: MIL-PRF-009000, Lubricating Oil, Shipboard Internal Combustion Engine, High-Output Diesel (LO6), 2011 Test Results

# Product Data

## LA6—2011 Data Summary

Table 3-15 displays LA6 results for the 2011 reporting period. Thirty-seven analyses were queried from the PQIS, representing 131.66 thousand U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

MIL-PRF-6081, Lubricating Oil, Jet Engine, Grade 1010						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
Acid Number (T.A.N): (mg KOH/g)		<b>0.10</b>	0.006	0.100	0.030	0.033
Viscosity:						
cs @ 37.8 °C	<b>10.0</b>		10.830	12.400	11.534	11.489
cs @ -40 °C		<b>3,000</b>	1,898.0	2,417.2	2,140.2	2,136.0
Viscosity Stability cs: (% Change @ 3 hours)						
-40 °C		<b>2</b>	0.00	1.28	0.59	0.61
Flash Point: (°C)	<b>132</b>		132.0	140.0	135.7	135.8
Pour Point: (°C)		<b>-57</b>	-66.0	-63.0	-64.5	-64.6
ASTM Color:		<b>No. 5.5</b>	1.5	1.5	1.5	1.5
Copper Strip Corrosion: (@ 100 ± °C)		<b>1</b>	1	1	1	1
Trace Sediment: (mL/200 mL of oil)		<b>0.005</b>	0.000	0.005	0.002	0.002

Table 3-15: MIL-PRF-6081, Lubricating Oil, Jet Engine, Grade 1010 (LA6), 2011 Test Results

## FSII—2011 Data Summary

Table 3-16 displays FSII results for the 2011 reporting period. Three hundred eighty-five analyses were queried from the PQIS, representing 1.91 million U.S. gallons. All batches met specification requirements for all fuel properties measured in 2011.

<b>MIL-DTL-85470, Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745 (FSII)</b>						
<b>Property</b>	<b>Specification Limits</b>		<b>2011 Test Results</b>			
	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>Wt Mean</b>
<b>Acid Number:</b> (mg KOH/g)		<b>0.09</b>	0.000	0.090	0.013	0.013
<b>Color:</b> (platinum cobalt)		<b>10</b>	0.00	9.00	2.84	2.84
<b>Distillation:</b>						
Initial Point (°C)	<b>191.0</b>		191.4	195.0	193.3	193.3
Dry Point (°C)		<b>198.0</b>	194.6	197.9	195.4	195.4
<b>Ethylene Glycol:</b> (% by weight)		<b>0.5</b>	0.000	0.100	0.011	0.011
<b>pH of 25% solution in water:</b> (25+/- °C)	<b>5.5</b>	<b>7.5</b>	5.90	7.50	6.89	6.89
<b>Relative Density:</b> (20/20 °C)	<b>1.021</b>	<b>1.025</b>	1.021	1.024	1.022	1.022
<b>Water:</b> (mass %)		<b>0.1</b>	0.0000	0.0680	0.0163	0.0162
<b>Flash Point:</b> (°C)	<b>85</b>		85.0	104.0	93.0	92.8

Table 3-16: MIL-DTL-85470, Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745 (FSII), 2011 Test Results

## 2011 Product Detailed Assessment Reporting

Product detailed assessments provide minimum, maximum, mean, and volumetrically weighted mean values for each fuel property of the specified grade. These values are presented in table form, providing volumes processed through the PQIS database and regional sources. Also provided are histograms. When significant trending is observed, trend charts based on weighted mean values are presented.

The conformance tables are illustrative in nature and may not represent 100 percent of the particular fuel characteristic, but they delineate sufficient data points to provide an accurate representation. The arithmetic means are based on “occurrence averages”—for example, averaging on submitted data for the characteristic. The tables reflect the number of reports constituting the data set and the corresponding volume in millions of gallons.

Comments noting observed trends are included in the assessment summary for each product where appropriate. These data reflect “Level A procurement quality test data” and do not include values throughout the distribution cycle.

The Level A data reflecting the spectender terminal source or refinery testing set the baseline in fuel quality considerations downstream. Various transport mediums (pipeline, tankers, and tank-trucks) and storage conditions can affect product quality.

Batch integrity may also be compromised during the process. DLA Energy-QT can provide transportation data for first-, second-, and third-tier bulk deliveries, but not information on distribution or what constitutes an individual allotment.

Test properties reported in the following sections are specific to JP8, JP5, JA1, F76, MGO, and TS1. Trends noted in this section are general in nature. Tables showing regional statistics are also provided. Most fuels met all specification requirements. In the few batches where test results were off specification, they were waived, reported incorrectly by the refiner, or transcribed into the database incorrectly.



# JP8–2011 Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)			
Property	2011 Source Inputs		
	Region	Volume	Analysis
<b>Total Acid Number:</b> (mg KOH/g)	All	1,790.19	1,435
<b>Aromatics:</b> (vol %)	All	1,786.85	1,434
<b>Sulfur Mercaptan:</b> (mass %)	All	1,568.44	1,249
<b>Sulfur, Total:</b> (mass %)	All	1,785.81	1,426
<b>Distillation:</b>			
Initial Boiling Point (IBP) (°C)	All	1,818.31	1,533
10% recovered, (°C)	All	1,825.71	1,542
20% recovered, (°C)	All	1,755.01	1,509
50% recovered, (°C)	All	1,825.71	1,542
90% recovered, (°C)	All	1,825.71	1,542
Final Boiling Point (FBP), (°C)	All	1,825.65	1,541
Residue, (vol %)	All	1,607.08	1,335
Loss, (vol %)	All	1,606.77	1,334
<b>Flash Point:</b> (°C)	All	1,815.11	1,538
<b>Density:</b> (kg/L @ 15 °C)	All	1,814.37	1,538
<b>Freezing Point:</b> (°C)	All	1,821.63	1,537
<b>Viscosity:</b> (mm²/s @ -20 °C)	All	1,785.76	1,430
<b>Net Heat of Combustion:</b> (MJ/kg)	All	1,730.67	1,334
<b>Cetane Index:</b> (calculated)	All	1,776.27	1,522
<b>Hydrogen Content:</b> (mass %)	All	1,692.46	1,396
<b>Smoke Point:</b> (mm)	All	1,782.77	1,436
<b>Naphthalene:</b> (vol %)	All	1,264.22	1,013
<b>Thermal Stability:</b>			
Change in pressure drop, mm Hg @ 275°C	All	1,515.44	1,287
Change in pressure drop, mm Hg @ 260°C	All	124.99	104
<b>Existent Gum:</b> (mg/100 mL)	All	1,792.59	1,533
<b>Particulate Matter:</b> (mg/L)	All	1,815.35	1,536
<b>Filtration Time:</b> (minutes)	All	1,806.56	1,534
<b>Water Separation Index:</b> (rating)	All	1,744.96	1,412
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	All	539.47	709

Table 4-1: Data Summary, MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8), 2011 Source Inputs

# JP8–2011 Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.000	0.020	0.006	0.006
<b>Aromatics:</b> (vol %)		<b>25.0</b>	7.0	24.5	16.86	17.61
<b>Sulfur Mercaptan:<sup>1</sup></b> (mass %)		<b>0.002</b>	0.0000	0.0020	0.0009	0.0009
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.000	0.280	0.057	0.062
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	<b>Report</b>		90.0	194.5	150.5	151.7
10% recovered, <sup>2</sup> (°C)	<b>205<sup>(186)</sup></b>		150.0	202.6	173.2	172.5
20% recovered, (°C)	<b>Report</b>		161.5	207.0	180.8	180.4
50% recovered, (°C)	<b>Report</b>		176.0	249.0	200.4	200.1
90% recovered, (°C)	<b>Report</b>		201.2	291.0	240.0	241.7
Final Boiling Point (FBP), <sup>2,3</sup> (°C)	<b>300<sup>(330)</sup></b>		219.0	310.6	265.7	267.1
Residue, (vol %)	<b>1.5</b>		0.05	1.50	1.06	1.09
Loss, (vol %)	<b>1.5</b>		0.00	1.50	0.77	0.83
<b>Flash Point:</b> (°C)	<b>38</b>		38.0	74.0	49.2	48.0
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7809	0.8370	0.8050	0.8043
<b>Freezing Point:</b> (°C)		<b>-47</b>	-80.0	-47.0	-52.5	-52.4
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	2.862	7.200	4.399	4.334
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		42.900	43.600	43.215	43.222
<b>Cetane Index:</b> (calculated)	<b>Report</b>		30.2	69.5	42.6	42.9
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.30	16.49	13.84	13.82
<b>Smoke Point:<sup>4</sup></b> (mm)	<b>25.0</b>		18.00	30.00	23.52	22.89
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.00	3.00	1.26	1.23
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275°C			0.00	23.00	0.50	0.49
Change in pressure drop, mm Hg @ 260°C	<b>25</b>		0.00	11.00	1.55	1.93
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.00	7.00	1.07	1.18
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.00	1.00	0.35	0.34
<b>Filtration Time:</b> (minutes)		<b>15</b>	1	15	5.91	6.04
<b>Water Separation Index:</b> (rating)	<b>70</b>		70	100	93.4	93.9
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.10	0.15	0.122	0.122

Table 4-2: Data Summary, MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene Types, NATO F34 (JP8), 2011 Test Results

**Note 1:** Either the sulfur mercaptan limit or a negative doctor test result is acceptable to meet the specification requirement.

**Note 2:** Test method D2887 limits in parentheses (°C).

**Note 3:** FBP maximum results meet D2887 upper limits of 330 °C.

**Note 4:** When the smoke point result is below 25 mm, the product is acceptable so long as the naphthalene content is below 3.0 percent and the smoke point is above the minimum of 19 mm.

# JP8–2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		8.11			
	Batch Analysis		9			
	Specification Limits		Region 1			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0020	0.0150	0.007	0.006
<b>Aromatics:</b> (vol %)		<b>25.0</b>	18.4	20.2	19.2	19.2
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0004	0.0020	0.0012	0.0013
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.1630	0.2140	0.185	0.183
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	<b>Report</b>		150.1	150.1	150.1	150.1
10% recovered, (°C)			<b>205<sup>(186)</sup></b>	167.7	173.6	170.5
20% recovered, (°C)	<b>Report</b>		174.4	180.5	177.3	177.0
50% recovered, (°C)	<b>Report</b>		189.2	198.3	193.7	193.3
90% recovered, (°C)	<b>Report</b>		223.0	238.5	231.8	231.6
Final Boiling Point (FBP), (°C)	<b>300<sup>(330)</sup></b>		248.1	262.5	256.5	256.2
Residue, (vol %)	<b>1.5</b>		0.05	1.10	0.69	0.78
Loss, (vol %)	<b>1.5</b>		0.20	0.90	0.52	0.57
<b>Flash Point:</b> (°C)	<b>38</b>		39.0	45.0	42.4	42.5
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7891	0.7970	0.7929	0.7927
<b>Freezing Point:</b> (°C)		<b>-47</b>	-65.0	-47.0	-52.5	-53.6
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.373	3.982	3.718	3.709
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.220	43.280	43.258	43.259
<b>Cetane Index:</b> (calculated)	<b>Report</b>		43.9	45.6	44.7	44.7
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.79	13.92	13.86	13.86
<b>Smoke Point:</b> (mm)	<b>25.0</b>		19.0	25.0	23.0	23.4
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.84	1.73	1.24	1.23
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	<b>25</b>		0.00	1.00	0.44	0.51
Change in pressure drop, mm Hg @ 260 °C			NR	NR	NR	NR
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	1.00	2.00	1.23	1.28
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.18	1.00	0.44	0.47
<b>Filtration Time:</b> (minutes)		<b>15</b>	8	10	8.78	8.92
<b>Water Separation Index:</b> (rating)	<b>70</b>		98	98	98.0	98.0
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.10	0.14	0.120	0.122

Table 4-3: Region 1 Summary

# JP8—2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		228.70			
	Batch Analysis		321			
	Specification Limits		Region 2			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0010	0.0149	0.004	0.004
<b>Aromatics:</b> (vol %)		<b>25.0</b>	9.4	24.4	16.5	16.2
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0000	0.0016	0.0006	0.0007
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0006	0.1070	0.047	0.056
<b>Distillation:</b>						
Initial Boiling Point (IBP), (°C)	Report		90.0	194.5	136.3	147.0
10% recovered, (°C)	205 <sup>(186)</sup>		150.0	202.6	175.5	180.6
20% recovered, (°C)	Report		165.0	207.0	185.9	189.8
50% recovered, (°C)	Report		190.0	249.0	208.0	209.1
90% recovered, (°C)	Report		213.0	291.0	243.5	241.9
Final Boiling Point (FBP), (°C)	300 <sup>(330)</sup>		231.0	310.6	274.3	269.4
Residue, (vol %)	1.5		0.50	1.50	1.09	1.13
Loss, (vol %)	1.5		0.00	1.50	0.76	0.81
<b>Flash Point:</b> (°C)	<b>38</b>		39.0	74.0	54.4	56.2
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7996	0.8208	0.8065	0.8079
<b>Freezing Point:</b> (°C)		<b>-47</b>	-61.3	-47.7	-52.1	-51.6
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.200	6.900	4.867	5.017
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.122	43.373	43.234	43.238
<b>Cetane Index:</b> (calculated)	Report		38.8	46.7	44.4	44.5
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.46	16.49	13.92	14.02
<b>Smoke Point:</b> (mm)	<b>25.0</b>		20.0	28.0	23.9	23.9
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.10	2.19	1.26	1.21
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	25		0.00	23.00	0.32	0.22
Change in pressure drop, mm Hg @ 260 °C	NR		NR	NR	NR	NR
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.00	7.00	0.78	0.78
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.03	0.99	0.34	0.33
<b>Filtration Time:</b> (minutes)		<b>15</b>	1	14	5.61	5.69
<b>Water Separation Index:</b> (rating)	<b>70</b>		71	100	92.6	92.6
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.10	0.15	0.117	0.118

Table 4-4: Region 2 Summary

# JP8–2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		692.81			
	Batch Analysis		625			
	Specification Limits		Region 3			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)	0.015	0.0000	0.0150	0.006	0.005	
<b>Aromatics:</b> (vol %)	25.0	8.1	23.7	15.6	17.1	
<b>Sulfur Mercaptan:</b> (mass %)	0.002	0.0000	0.0020	0.0011	0.0011	
<b>Sulfur, Total:</b> (mass %)	0.30	0.0006	0.2000	0.048	0.057	
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	<b>Report</b>	113.0	187.0	157.9	155.4	
10% recovered, (°C)		205 <sup>(186)</sup>	160.0	197.0	175.8	175.7
20% recovered, (°C)	<b>Report</b>	166.0	201.0	182.1	183.4	
50% recovered, (°C)	<b>Report</b>	182.0	220.0	198.9	203.0	
90% recovered, (°C)	<b>Report</b>	201.2	260.6	233.8	241.1	
Final Boiling Point (FBP), (°C)	300 <sup>(330)</sup>	219.0	303.0	257.2	265.2	
Residue, (vol %)	1.5	0.10	1.50	1.02	1.06	
Loss, (vol %)	1.5	0.00	1.50	0.77	0.84	
<b>Flash Point:</b> (°C)	38	38.0	69.0	50.0	50.7	
<b>Density:</b> (kg/L @ 15 °C)	0.775	0.840	0.7809	0.8360	0.8017	0.8041
<b>Freezing Point:</b> (°C)		-47	-76.0	-47.0	-52.7	-50.9
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		8.0	2.910	7.200	4.420	4.603
<b>Net Heat of Combustion:</b> (MJ/kg)	42.8		43.000	43.520	43.256	43.244
<b>Cetane Index:</b> (calculated)	<b>Report</b>	33.9	69.5	43.4	44.0	
<b>Hydrogen Content:</b> (mass %)		13.4	13.40	14.52	13.90	13.85
<b>Smoke Point:</b> (mm)	25.0		19.0	30.0	24.4	23.0
<b>Naphthalene:</b> (vol %)		3.0	0.00	3.00	0.99	1.23
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	25	0.00	22.00	0.64	0.49	
Change in pressure drop, mm Hg @ 260 °C		0.00	9.00	4.00	5.61	
<b>Existent Gum:</b> (mg/100 mL)		7.0	0.00	7.00	1.04	1.26
<b>Particulate Matter:</b> (mg/L)		1.0	0.00	1.00	0.32	0.29
<b>Filtration Time:</b> (minutes)		15	2	15	5.62	5.45
<b>Water Separation Index:</b> (rating)	70		70	100	92.7	93.7
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	0.10	0.15	0.10	0.15	0.124	0.123

Table 4-5: Region 3 Summary

# JP8—2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		47.23			
	Batch Analysis		94			
	Specification Limits		Region 4			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0008	0.0140	0.003	0.003
<b>Aromatics:</b> (vol %)		<b>25.0</b>	7.3	24.5	16.2	15.5
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0000	0.0020	0.0008	0.0009
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0001	0.0808	0.027	0.036
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)		<b>Report</b>	132.5	186.0	158.0	153.8
10% recovered, (°C)		<b>205<sup>(186)</sup></b>	157.0	194.0	177.7	175.2
20% recovered, (°C)		<b>Report</b>	166.0	198.7	184.5	182.4
50% recovered, (°C)		<b>Report</b>	179.0	216.6	202.7	202.0
90% recovered, (°C)		<b>Report</b>	216.0	253.2	240.7	241.3
Final Boiling Point (FBP), (°C)		<b>300<sup>(330)</sup></b>	250.1	281.8	267.1	266.5
Residue, (vol %)		<b>1.5</b>	0.20	1.40	0.88	0.95
Loss, (vol %)		<b>1.5</b>	0.00	1.00	0.55	0.50
<b>Flash Point:</b> (°C)	<b>38</b>		42.0	62.0	49.2	47.5
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7932	0.8227	0.8076	0.8060
<b>Freezing Point:</b> (°C)		<b>-47</b>	-71.0	-47.0	-52.6	-51.3
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.280	6.276	4.685	4.568
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.000	43.500	43.224	43.234
<b>Cetane Index:</b> (calculated)		<b>Report</b>	38.2	46.7	42.8	43.0
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.40	14.20	13.81	13.84
<b>Smoke Point:</b> (mm)	<b>25.0</b>		22.0	30.0	25.6	25.6
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.01	3.00	1.07	1.21
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	1.00	0.15	0.18
Change in pressure drop, mm Hg @ 260 °C			0.00	11.00	0.48	0.77
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.00	5.40	1.38	1.49
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.00	1.00	0.27	0.24
<b>Filtration Time:</b> (minutes)		<b>15</b>	5	14	7.38	6.99
<b>Water Separation Index:</b> (rating)	<b>70</b>		71	100	95.4	96.8
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.10	0.15	0.117	0.115

Table 4-6: Region 4 Summary

# JP8–2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		312.52			
	Batch Analysis		194			
	Specification Limits		Region 5			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0000	0.0150	0.004	0.004
<b>Aromatics:</b> (vol %)		<b>25.0</b>	7.0	24.1	18.3	18.9
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0000	0.0020	0.0007	0.0005
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0000	0.1700	0.056	0.019
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	Report		123.2	180.9	155.4	154.3
10% recovered, (°C)	205 <sup>(186)</sup>		161.5	197.4	173.5	172.3
20% recovered, (°C)	Report		168.8	199.6	180.5	179.7
50% recovered, (°C)	Report		193.8	215.7	204.0	203.3
90% recovered, (°C)	Report		233.0	272.0	251.2	249.3
Final Boiling Point (FBP), (°C)	300 <sup>(330)</sup>		255.0	292.0	277.5	274.5
Residue, (vol %)	1.5		0.10	1.50	1.17	1.06
Loss, (vol %)	1.5		0.00	1.50	0.71	0.71
<b>Flash Point:</b> (°C)	<b>38</b>		41.0	66.0	49.6	46.2
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.8026	0.8370	0.8199	0.8163
<b>Freezing Point:</b> (°C)		-47	-75.0	-47.0	-54.2	-54.3
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.462	6.500	4.688	4.547
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		42.900	43.200	43.087	43.099
<b>Cetane Index:</b> (calculated)	Report		30.2	44.9	38.7	40.4
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.30	13.90	13.53	13.56
<b>Smoke Point:</b> (mm)	<b>25.0</b>		18.0	23.0	20.2	19.9
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.17	2.74	1.33	1.06
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C			0.00	2.00	0.05	0.02
Change in pressure drop, mm Hg @ 260 °C	25		0.00	9.00	6.67	7.76
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.00	5.00	1.08	0.98
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.00	1.00	0.25	0.17
<b>Filtration Time:</b> (minutes)		<b>15</b>	2	11	4.71	4.99
<b>Water Separation Index:</b> (rating)	<b>70</b>		80	100	94.6	94.8
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.11	0.15	0.123	0.143

Table 4-7: Region 5 Summary

# JP8—2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		189.09			
	Batch Analysis		88			
	Specification Limits		Region 6			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0100	0.0100	0.010	0.010
<b>Aromatics:</b> (vol %)		<b>25.0</b>	17.0	21.6	19.7	19.5
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0005	0.0015	0.0009	0.0009
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0240	0.0500	0.033	0.034
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	Report		144.0	149.0	146.9	147.0
10% recovered, (°C)	205 <sup>(186)</sup>		159.0	163.0	160.5	160.5
20% recovered, (°C)	Report		164.0	170.0	166.0	166.2
50% recovered, (°C)	Report		183.0	191.0	186.0	186.1
90% recovered, (°C)	Report		235.0	248.0	241.3	241.5
Final Boiling Point (FBP), (°C)	300 <sup>(330)</sup>		261.0	282.0	271.9	271.9
Residue, (vol %)	1.5		1.00	1.30	1.17	1.18
Loss, (vol %)	1.5		1.00	1.30	1.00	1.01
<b>Flash Point:</b> (°C)	<b>38</b>		38.0	40.0	38.7	38.6
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7883	0.7986	0.7897	0.7900
<b>Freezing Point:</b> (°C)		<b>-47</b>	-51.5	-50.0	-50.7	-50.7
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.110	3.560	3.249	3.256
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.267	43.369	43.310	43.311
<b>Cetane Index:</b> (calculated)	Report		41.5	44.0	42.4	42.4
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.81	13.94	13.88	13.88
<b>Smoke Point:</b> (mm)	<b>25.0</b>		25.0	25.0	25.0	25.0
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	NR	NR	NR	NR
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	25		2.00	2.00	2.00	2.00
Change in pressure drop, mm Hg @ 260 °C	25		2.00	2.00	2.00	2.00
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	1.00	1.00	1.00	1.00
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.36	0.86	0.61	0.59
<b>Filtration Time:</b> (minutes)		<b>15</b>	10	13	11.77	11.79
<b>Water Separation Index:</b> (rating)	<b>70</b>		91	98	95.2	95.2
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.12	0.12	0.120	0.120

Table 4-8: Region 6 Summary

# JP8–2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		201.91			
	Batch Analysis		56			
	Specification Limits		Region 7			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0010	0.0100	0.007	0.007
<b>Aromatics:</b> (vol %)		<b>25.0</b>	15.0	20.5	16.5	16.6
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0003	0.0020	0.0014	0.0013
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0130	0.2800	0.161	0.159
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	Report		134.6	171.4	146.9	146.9
10% recovered, (°C)	205 <sup>(186)</sup>		158.0	184.5	167.0	167.3
20% recovered, (°C)	Report		161.5	188.8	172.8	173.2
50% recovered, (°C)	Report		176.0	202.9	189.4	189.6
90% recovered, (°C)	Report		209.0	246.0	230.1	229.9
Final Boiling Point (FBP), (°C)	300 <sup>(330)</sup>		238.0	279.0	256.8	256.4
Residue, (vol %)	1.5		0.30	1.50	1.18	1.18
Loss, (vol %)	1.5		0.30	1.30	0.83	0.84
<b>Flash Point:</b> (°C)	<b>38</b>		42.0	54.0	45.0	45.0
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7860	0.8163	0.7937	0.7942
<b>Freezing Point:</b> (°C)		<b>-47</b>	-80.0	-48.0	-58.1	-58.8
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	2.862	4.522	3.546	3.553
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		43.100	43.600	43.287	43.282
<b>Cetane Index:</b> (calculated)	Report		36.7	46.4	42.8	42.7
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.43	14.52	13.96	13.95
<b>Smoke Point:</b> (mm)	<b>25.0</b>		20.0	26.0	24.4	24.3
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.10	0.33	0.26	0.25
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	25		0.00	9.00	1.71	1.85
Change in pressure drop, mm Hg @ 260 °C	NR		NR	NR	NR	NR
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	1.00	4.00	1.84	1.75
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.21	1.00	0.60	0.59
<b>Filtration Time:</b> (minutes)		<b>15</b>	3	13	4.86	4.92
<b>Water Separation Index:</b> (rating)	<b>70</b>		71	100	94.5	94.4
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.11	0.14	0.128	0.129

Table 4-9: Region 7 Summary

# JP8—2011 Regional Data Summary

MIL-DTL-83133 Turbine Fuel, Aviation Kerosene Types, NATO F34 (JP8)						
Property	Total Volume		145.88			
	Batch Analysis		157			
	Specification Limits		Region 8			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0020	0.0200	0.014	0.010
<b>Aromatics:</b> (vol %)		<b>25.0</b>	13.6	24.5	19.7	18.7
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.002</b>	0.0002	0.0019	0.0008	0.0008
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0490	0.2000	0.101	0.100
<b>Distillation:</b>						
Initial Boiling Point (IBP) (°C)	<b>Report</b>		128.0	156.9	143.2	147.3
10% recovered, (°C)			<b>205<sup>(186)</sup></b>	157.2	174.0	164.6
20% recovered, (°C)	<b>Report</b>		166.6	181.8	172.0	174.2
50% recovered, (°C)	<b>Report</b>		191.0	205.0	197.7	197.9
90% recovered, (°C)	<b>Report</b>		235.7	256.0	246.7	245.7
Final Boiling Point (FBP), (°C)	<b>300<sup>(330)</sup></b>		245.2	281.0	266.6	266.0
Residue, (vol %)	<b>1.5</b>		0.20	1.40	1.06	1.12
Loss, (vol %)	<b>1.5</b>		0.00	1.50	0.80	0.95
<b>Flash Point:</b> (°C)	<b>38</b>		38.0	48.0	42.2	43.4
<b>Density:</b> (kg/L @ 15 °C)	<b>0.775</b>	<b>0.840</b>	0.7832	0.8152	0.8087	0.8060
<b>Freezing Point:</b> (°C)		<b>-47</b>	-62.4	-47.0	-49.3	-49.9
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.541	4.521	4.114	4.053
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.8</b>		42.900	43.348	43.105	43.165
<b>Cetane Index:</b> (calculated)	<b>Report</b>		35.0	45.7	39.7	40.7
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.44	14.00	13.82	13.77
<b>Smoke Point:</b> (mm)	<b>25.0</b>		20.0	24.0	21.3	21.8
<b>Naphthalene:</b> (vol %)		<b>3.0</b>	0.60	2.93	2.12	1.98
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	<b>25</b>		0.00	1.70	0.28	0.19
Change in pressure drop, mm Hg @ 260 °C			0.00	1.00	0.23	0.23
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.00	4.40	1.32	1.18
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.00	0.98	0.36	0.39
<b>Filtration Time:</b> (minutes)		<b>15</b>	4	14	5.23	5.57
<b>Water Separation Index:</b> (rating)	<b>70</b>		73	100	93.6	91.2
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.11	0.15	0.124	0.120

Table 4-10: Region 8 Summary

# JP8—Assessment Summary

## **Overview:**

In 2011, 1,544 reported analyses, representing 1,826.26 million U.S. gallons of JP8, were processed by Regions 1–8. This represents an increase in reported analyses (from 1,535) from 2010, but a decrease in volume (from 1,928.05 million U.S. gallons) queried from the PQIS in 2010.

## **Significant Trending:**

**Sulfur, Total.** The weighted mean decreased 0.013 mass percent from 2009 to 2011.

**Distillation Final Boiling Point.** The weighted mean decreased 6.3 °C from 2009 to 2011.

**Freezing Point.** The weighted mean decreased 1.6 °C from 2009 to 2011.

**Viscosity.** The weighted mean decreased 0.082 mm<sup>2</sup>/s @ -20 °C from 2009 to 2011.

**Naphthalene.** The weighted mean decreased 0.15 volume percent from 2009 to 2011.

**Particulate Matter.** The weighted mean decreased 0.044 mg/L from 2009 to 2011.

## **JP8 Observations:**

All batches met specification requirements in 2011.

For **Total Acid Number**, a waiver was granted for a 0.020 mg KOH/g maximum limit for locations in Alaska. Ninety-five measurements from Alaska were greater than the maximum specification limit of 0.015 mg KOH/g, but all met the specification limit set by the waiver. These data are included in the data tables and figures.

One **Hydrogen Content** value was less than the minimum JP8 specification limit of 13.4 mass percent. Two **Smoke Point** values were less than the minimum JP8 specification limit of 19.0 mm (when naphthalene values are less than 3.0 volume percent). Waivers were granted for these values. These data points are included in the data tables and figures.

For **Water Separation Index**, all JP8 batches met specification requirements. The impact of additives provides for a wide variation (see Table 4-11). Batches were not separated by type of additives or group of additives for this reporting. The minimum MSEP rating shall be as follows:

JP8 Additives	MSEP Rating, min
Antioxidant (AO), Metal Deactivator (MDA)	90
AO, MDA, and Fuel System Icing Inhibitor (FSII)	85
AO, MDA, and Corrosion Inhibitor/Lubricity Improver (CI/LI)	80
AO, MDA, FSII and CI/LI	70

Table 4-11: JP8 Additives and Associated MSEP Ratings

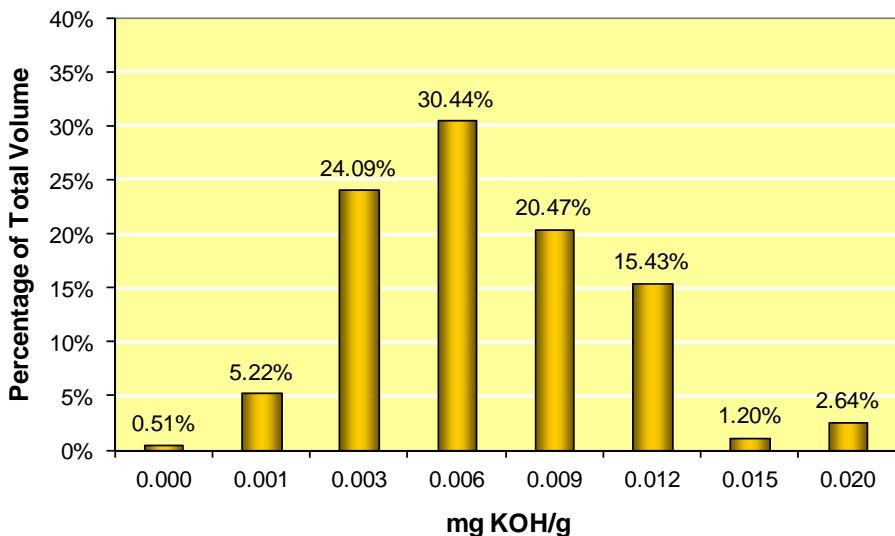
**Total Acid Number—2011**

Figure 4-1: Total Acid Number (mg KOH/g), maximum 0.015

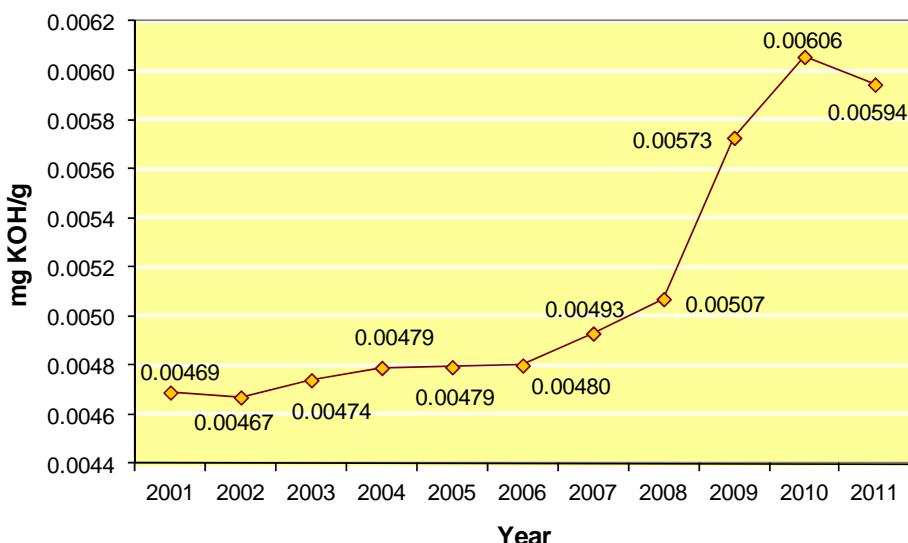
**Total Acid Number 11-Year Trend—Weighted Mean**

Figure 4-2: Total Acid Number (mg KOH/g), 11-Year Trend, maximum 0.015

## Aromatics—2011

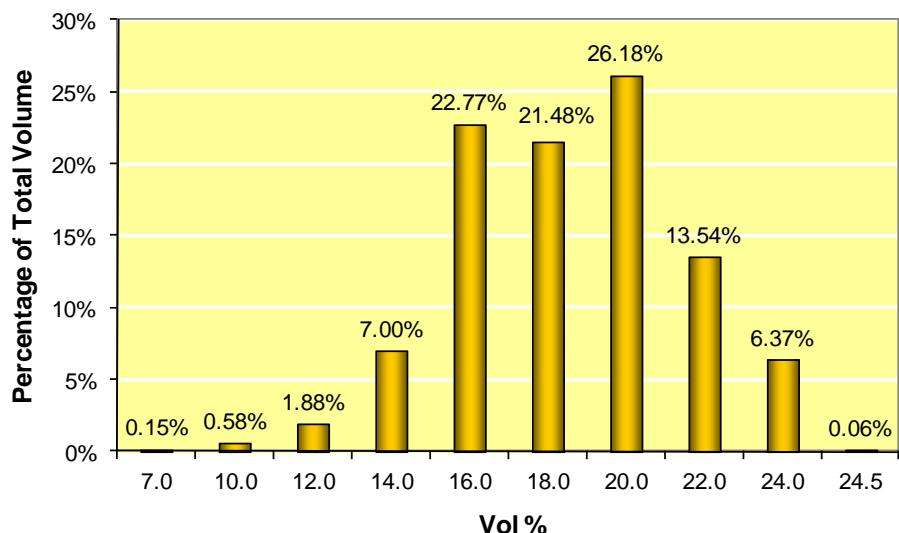


Figure 4-3: Aromatics (vol %), maximum 25.0

## Sulfur Mercaptan—2011

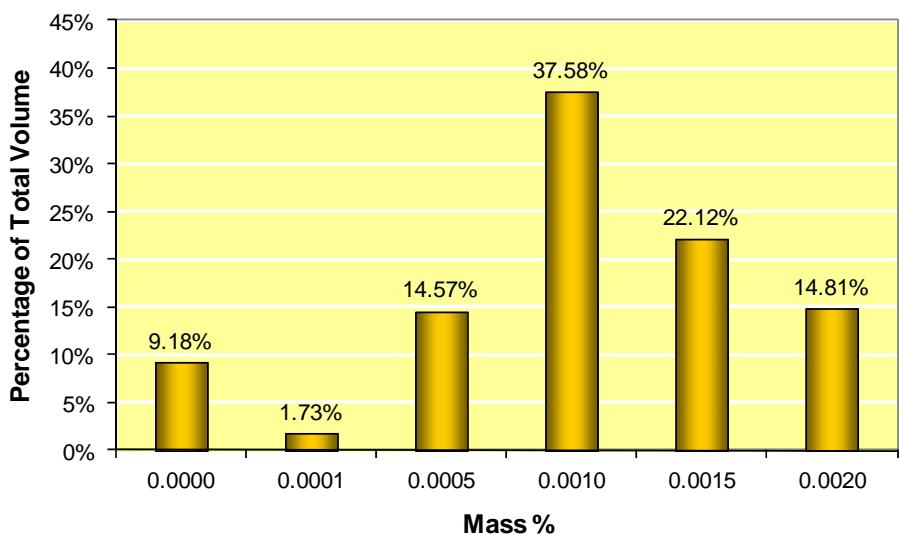


Figure 4-4: Sulfur Mercaptan (mass %), maximum 0.002

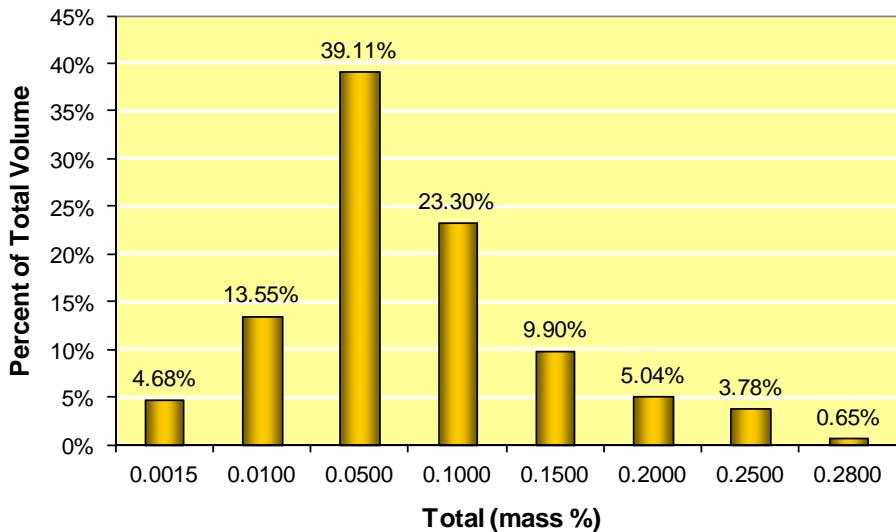
**Sulfur, Total—2011**

Figure 4-5: Sulfur, Total (mass %), maximum 0.30

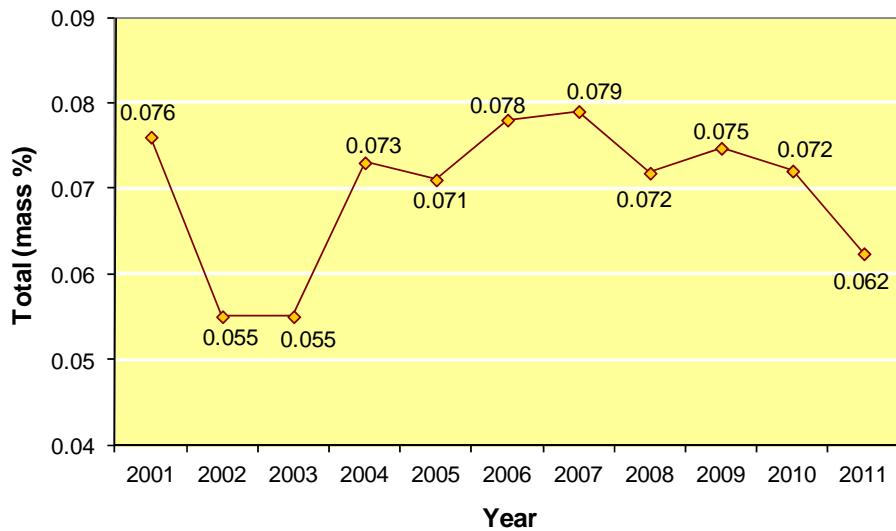
**Sulfur, Total 11-Year Trend—Weighted Mean**

Figure 4-6: Sulfur, Total (mass %), 11-Year Trend, maximum 0.30

## Distillation IBP—2011

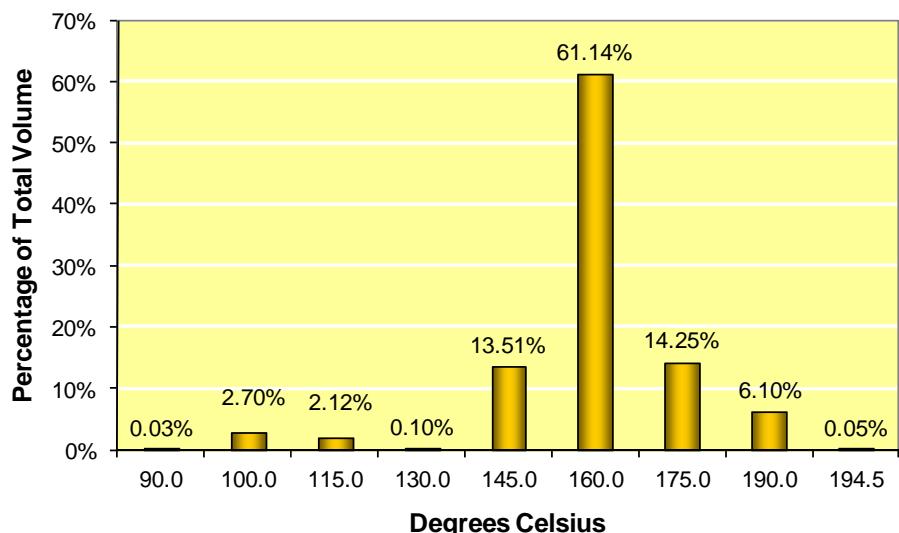


Figure 4-7: Distillation Initial Boiling Point (°C), Report

## Distillation 10% Recovered—2011

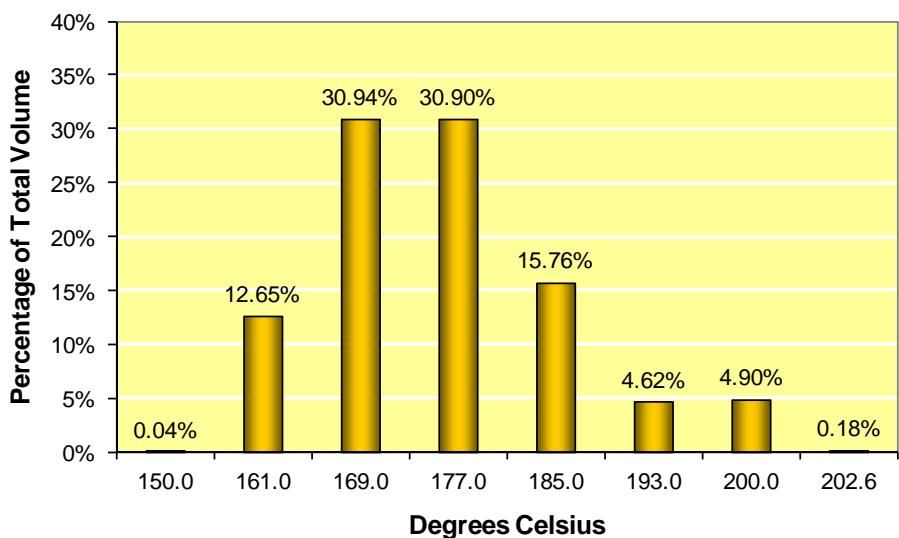


Figure 4-8: Distillation 10% Recovered (°C), maximum 205<sup>(186)</sup> (method D2887 limits in parentheses °C)

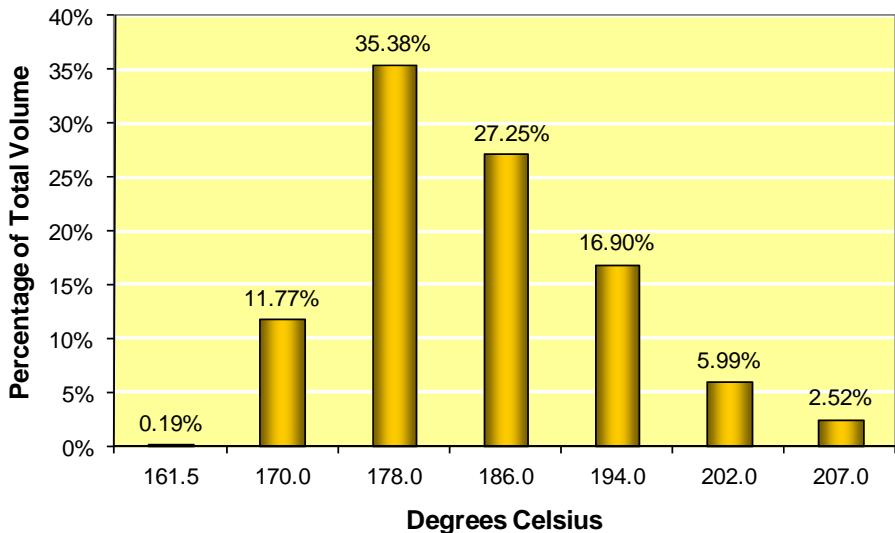
**Distillation 20% Recovered—2011**

Figure 4-9: Distillation 20% Recovered (°C), Report

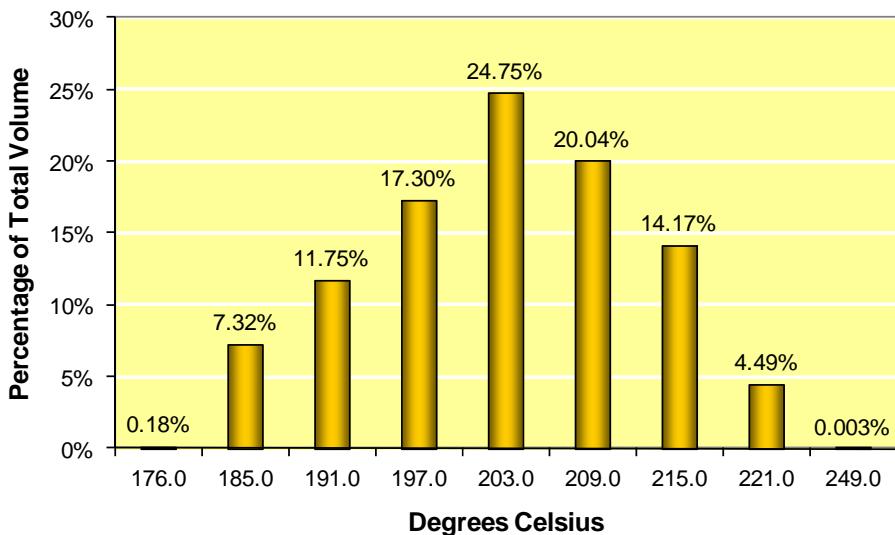
**Distillation 50% Recovered—2011**

Figure 4-10: Distillation 50% Recovered (°C), Report

# JP8 Data

## Distillation 90% Recovered—2011

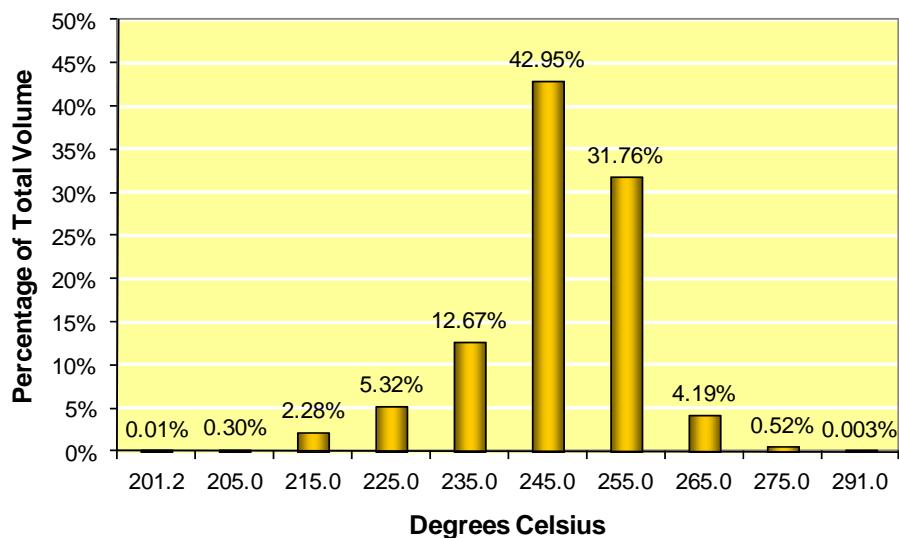


Figure 4-11: Distillation 90% Recovered (°C), Report



## Distillation FBP—2011

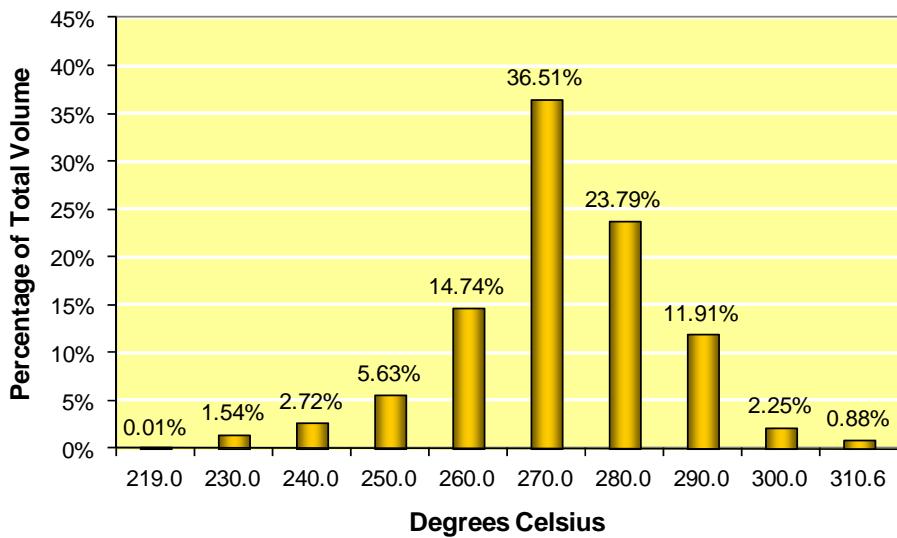


Figure 4-12: Distillation Final Boiling Point (°C), maximum 300<sup>(330)</sup> (method D2887 limits in parentheses °C)

## Distillation FBP 11-Year Trend—Weighted Mean

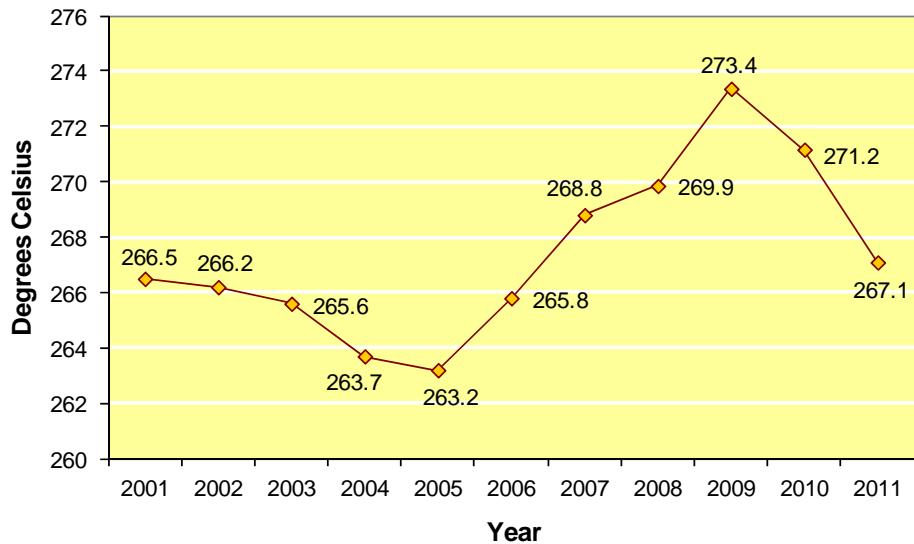


Figure 4-13: Distillation Final Boiling Point (°C), 11-Year Trend, maximum 300<sup>(330)</sup> (method D2887 limits in parentheses °C)

## Distillation Residue—2011

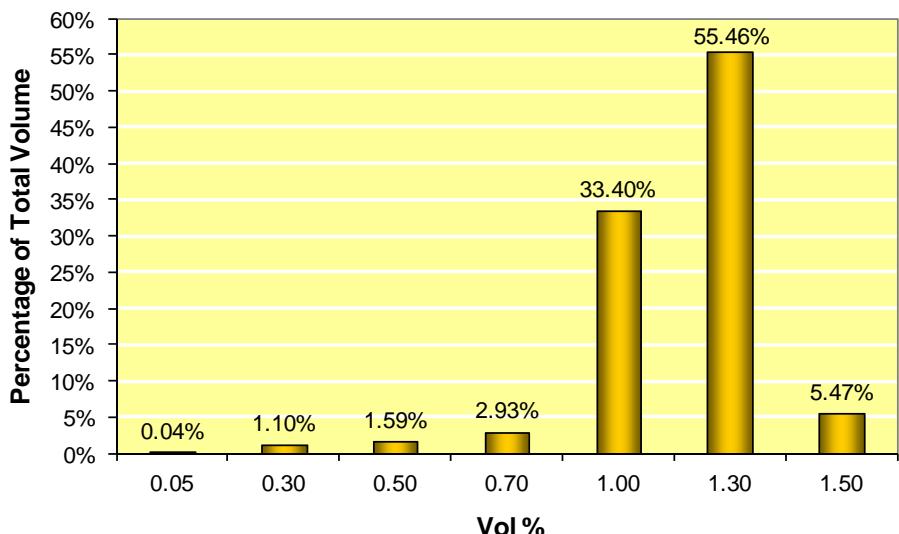


Figure 4-14: Distillation Residue (vol %), maximum 1.5

## Distillation Loss—2011

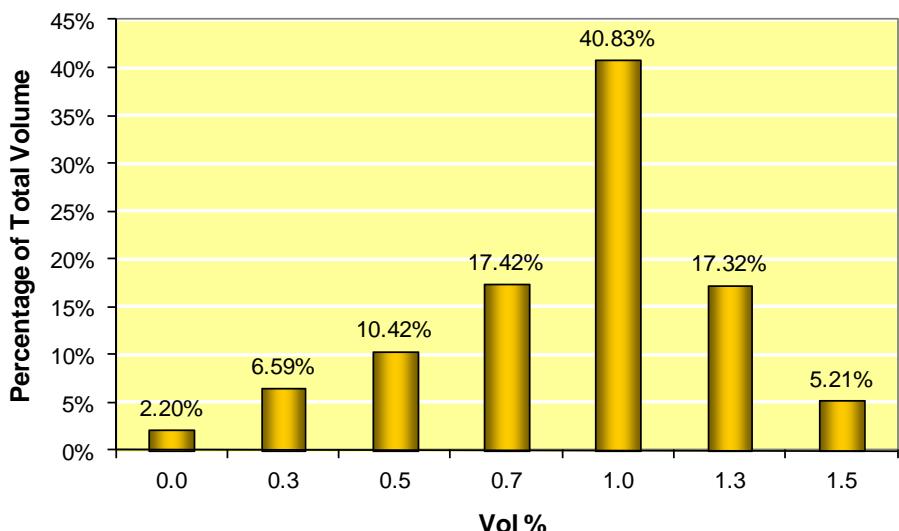


Figure 4-15: Distillation Loss (vol %), maximum 1.5

## Flash Point—2011

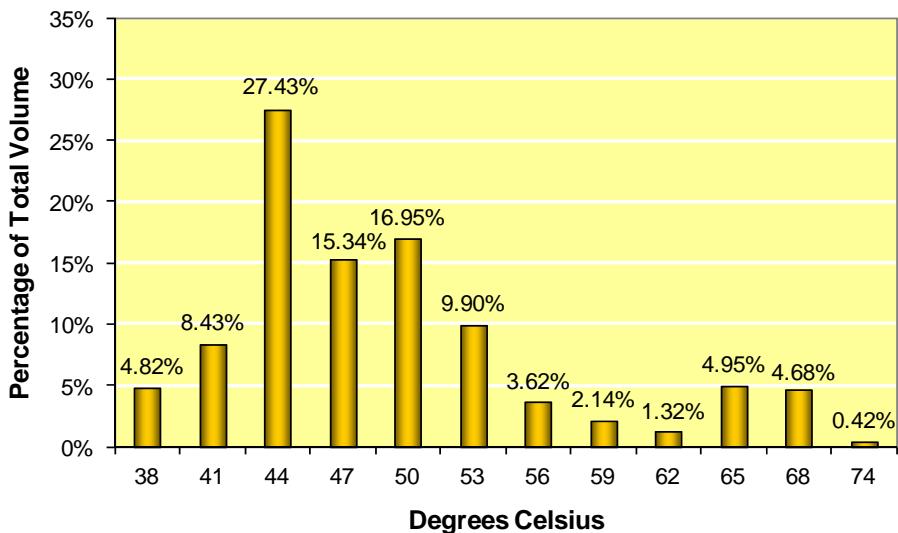


Figure 4-16: Flash Point (°C), minimum 38

## Density—2011

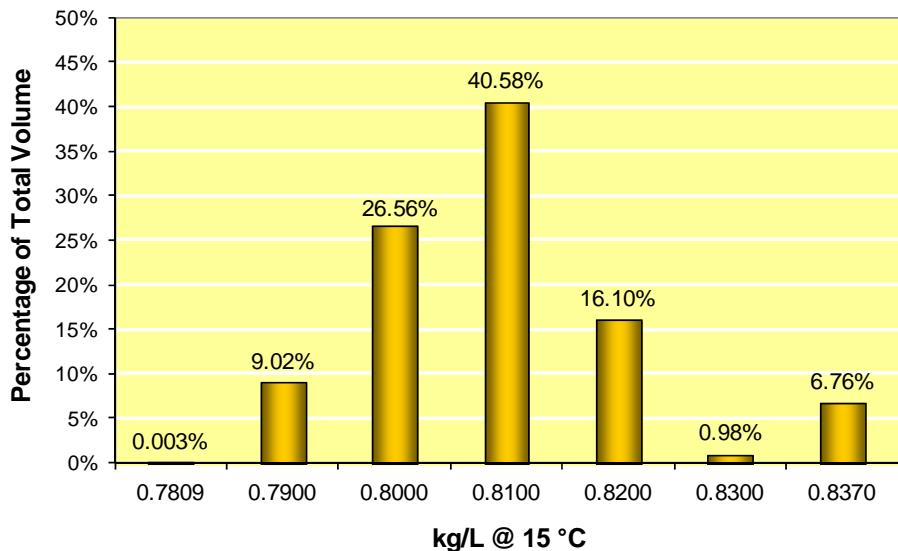


Figure 4-17: Density (kg/L @ 15 °C), minimum 0.775, maximum 0.840

## Freezing Point—2011

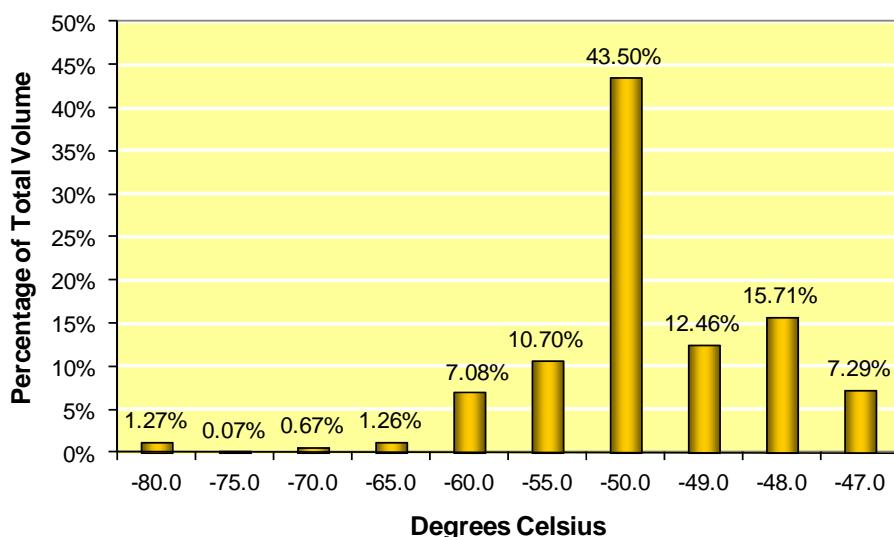


Figure 4-18: Freezing Point (°C), maximum –47

## Freezing Point 11-Year Trend—Weighted Mean

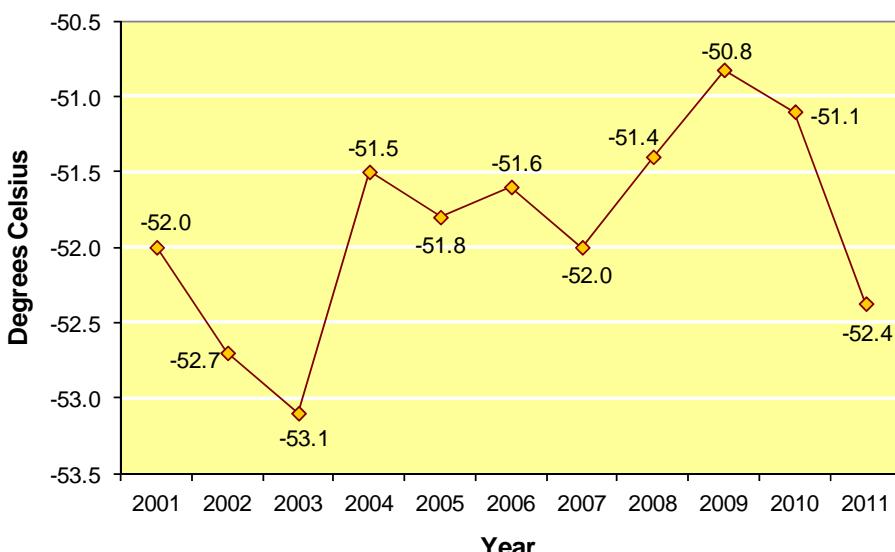
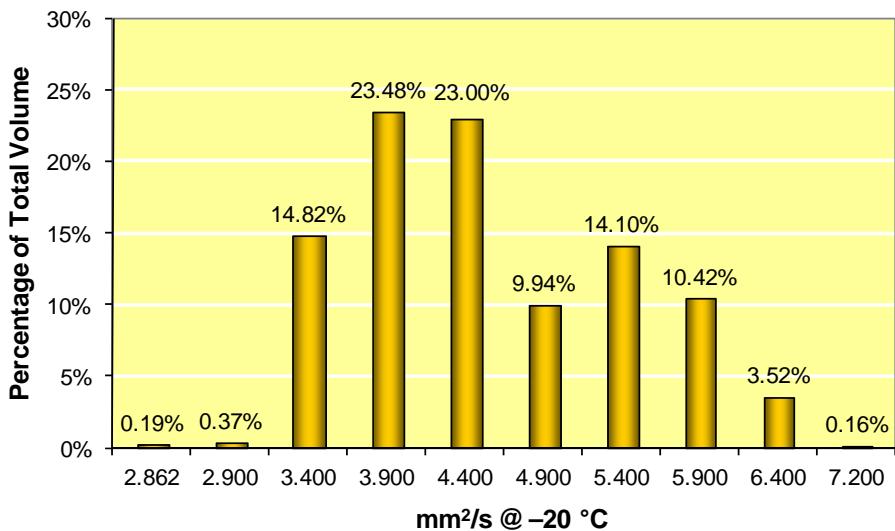
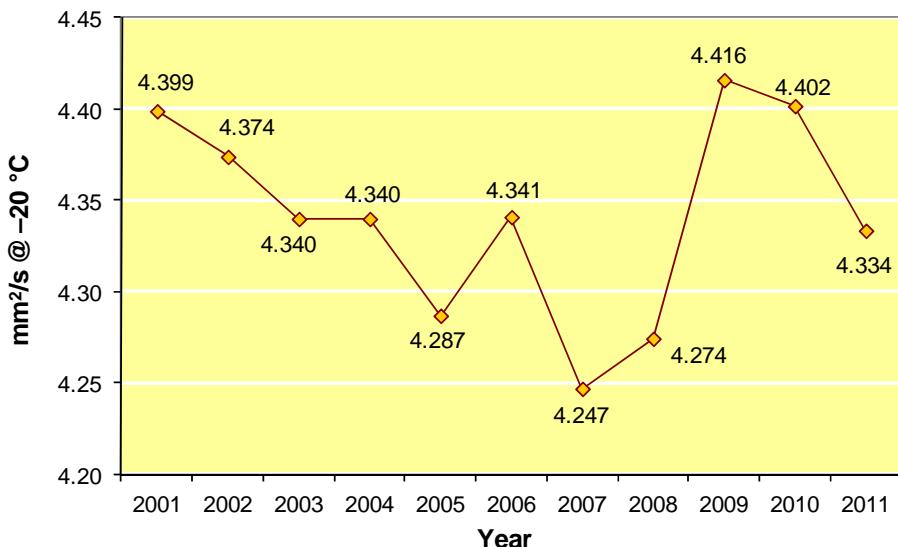


Figure 4-19: Freezing Point (°C), 11-Year Trend, maximum –47

**Viscosity—2011**Figure 4-20: Viscosity (mm<sup>2</sup>/s @ -20 °C), maximum 8.0**Viscosity 11-Year Trend—Weighted Mean**Figure 4-21: Viscosity (mm<sup>2</sup>/s @ -20 °C), 11-Year Trend, maximum 8.0

# JP8 Data

## Net Heat of Combustion—2011

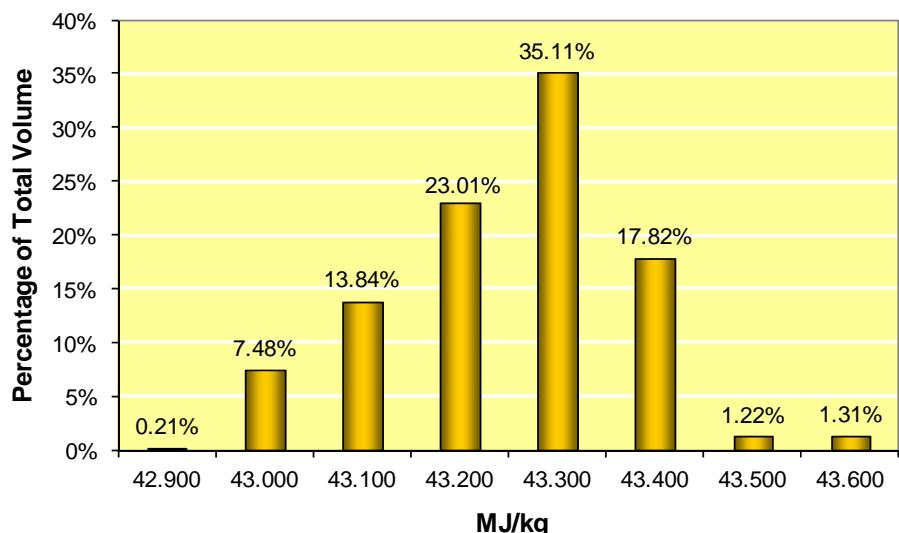


Figure 4-22: Net Heat of Combustion (MJ/kg), minimum 42.8

## Calculated Cetane Index—2011

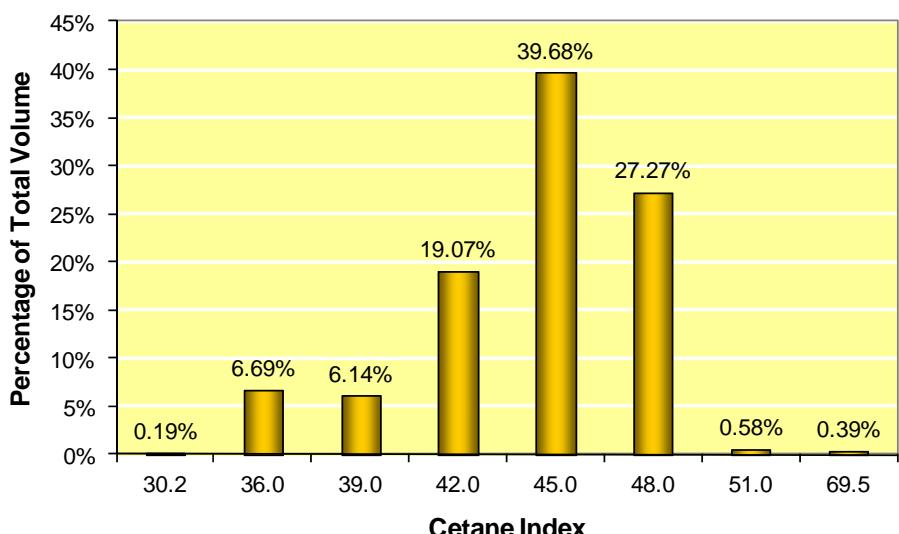


Figure 4-23: Calculated Cetane Index, Report

### Hydrogen Content—2011

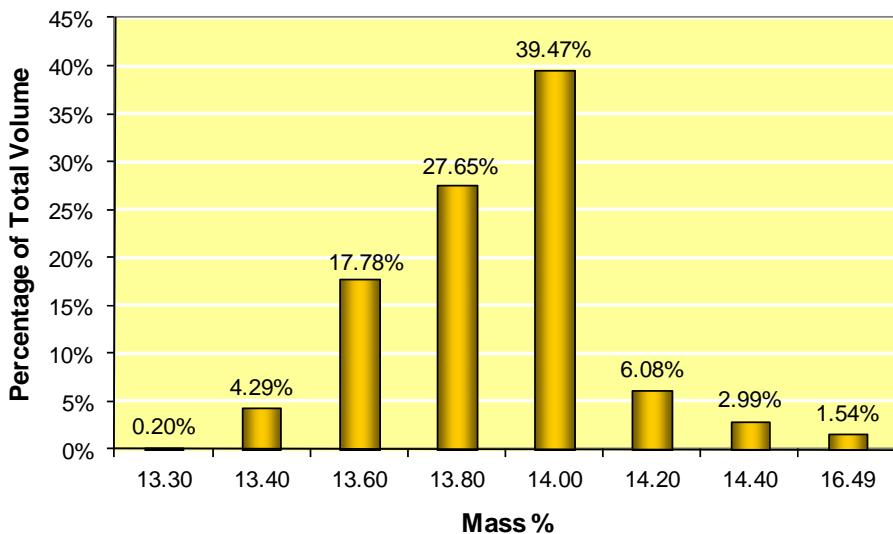


Figure 4-24: Hydrogen Content (mass %), minimum 13.4

### Smoke Point—2011

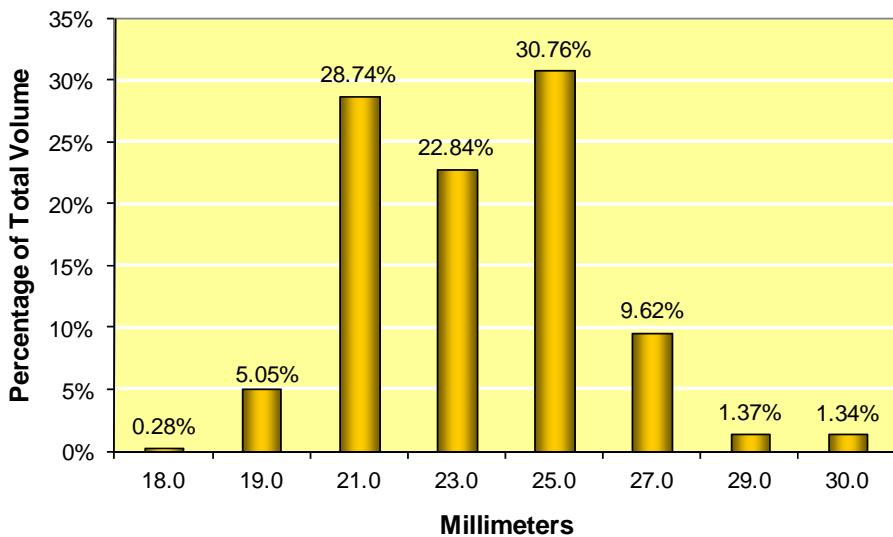


Figure 4-25: Smoke Point (mm), minimum 25.0

**NOTE:** When the smoke point result is below 25 mm, the product is acceptable so long as the naphthalene content is below 3.0 percent and the smoke point is above the minimum of 19 mm.

## Naphthalene—2011

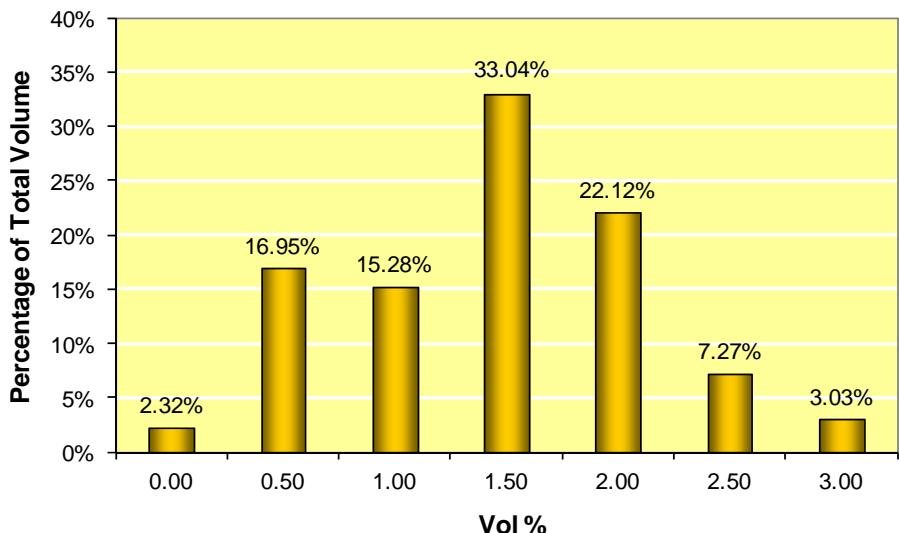


Figure 4-26: Naphthalene (vol %), maximum 3.0

## Naphthalene 11-Year Trend—Weighted Mean

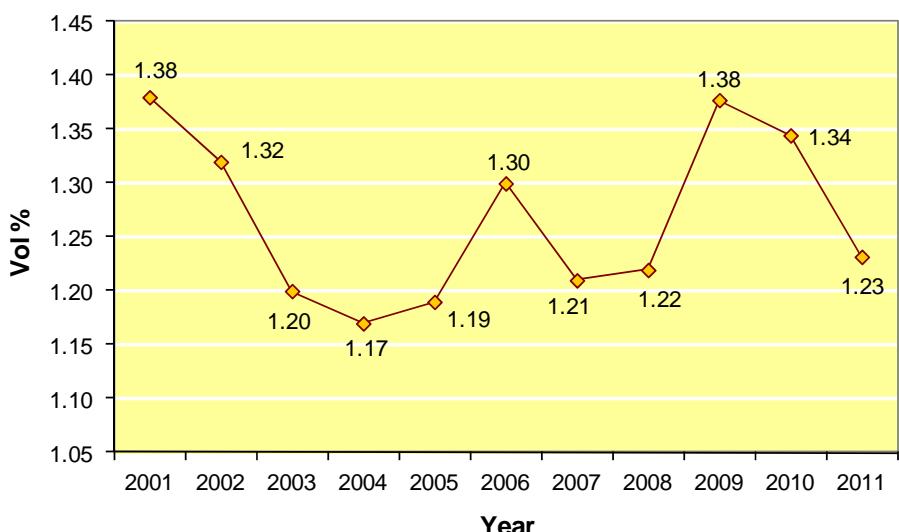


Figure 4-27: Naphthalene (vol %), 11-Year Trend, maximum 3.0

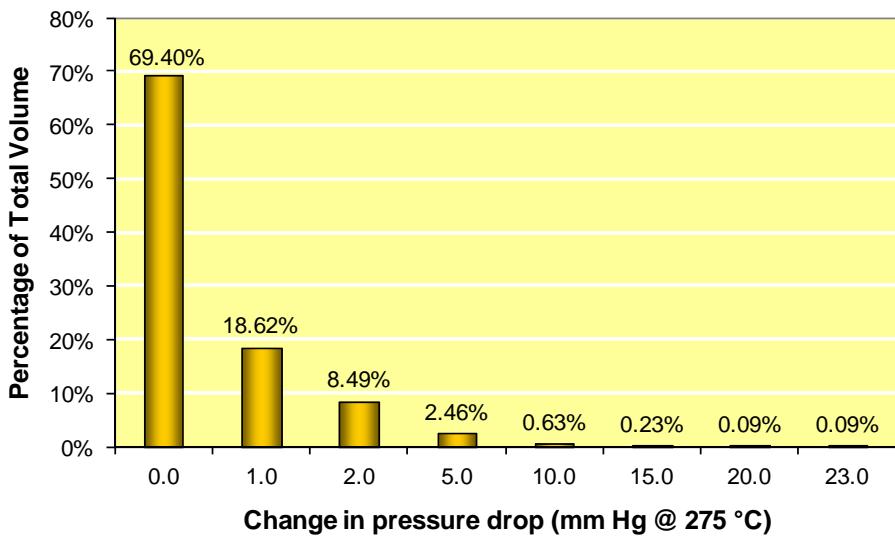
**Thermal Stability (JFTOT @ 275 °C)—2011**

Figure 4-28: Thermal Stability, Change in Pressure Drop (mm Hg @ 275 °C), maximum 25

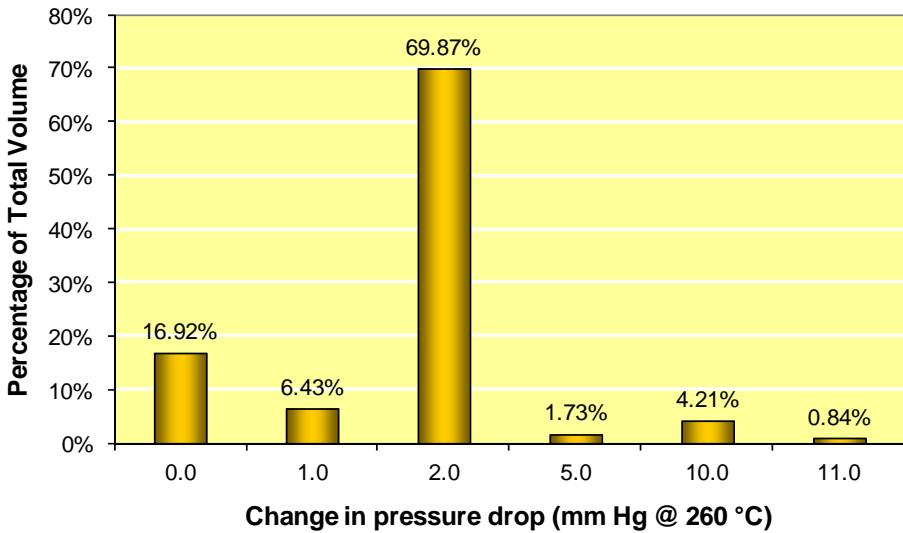
**Thermal Stability (JFTOT @ 260 °C)—2011**

Figure 4-29: Thermal Stability, Change in Pressure Drop (mm Hg @ 260 °C), maximum 25

## Existent Gum—2011

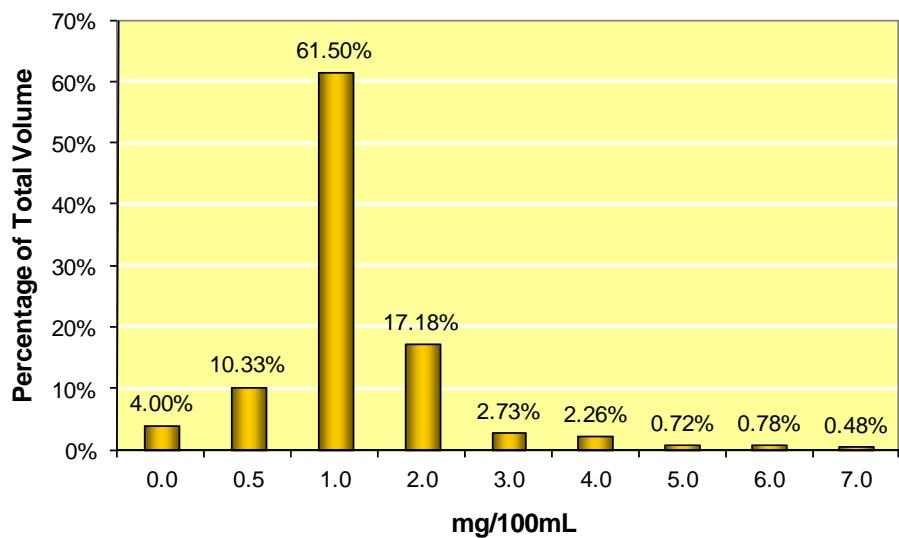


Figure 4-30: Existent Gum (mg/100 mL), maximum 7.0



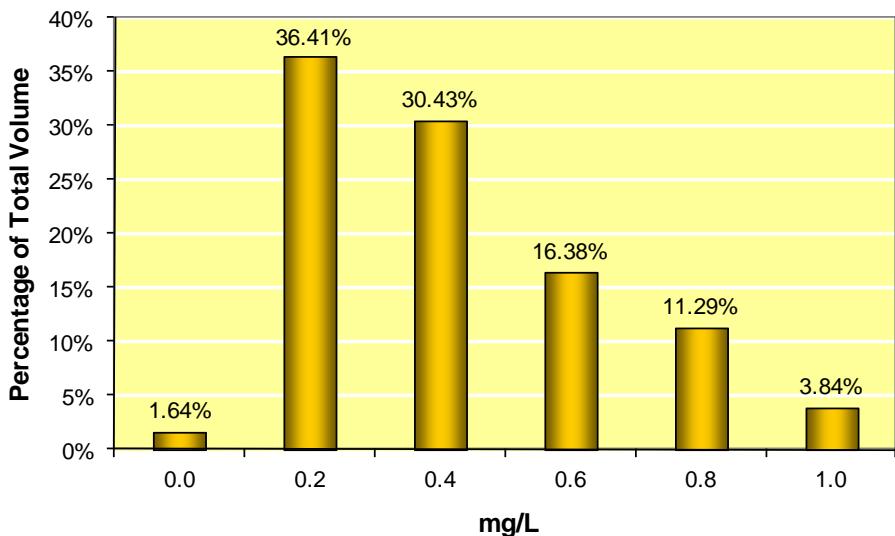
**Particulate Matter—2011**

Figure 4-31: Particulate Matter (mg/L), maximum 1.0

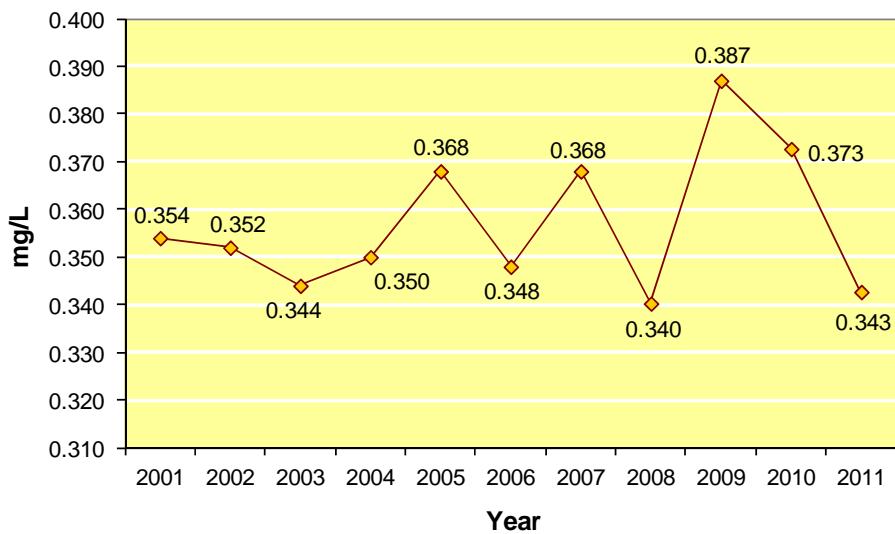
**Particulate Matter 11-Year Trend—Weighted Mean**

Figure 4-32: Particulate Matter (mg/L), 11-Year Trend, maximum 1.0

## Filtration Time—2011

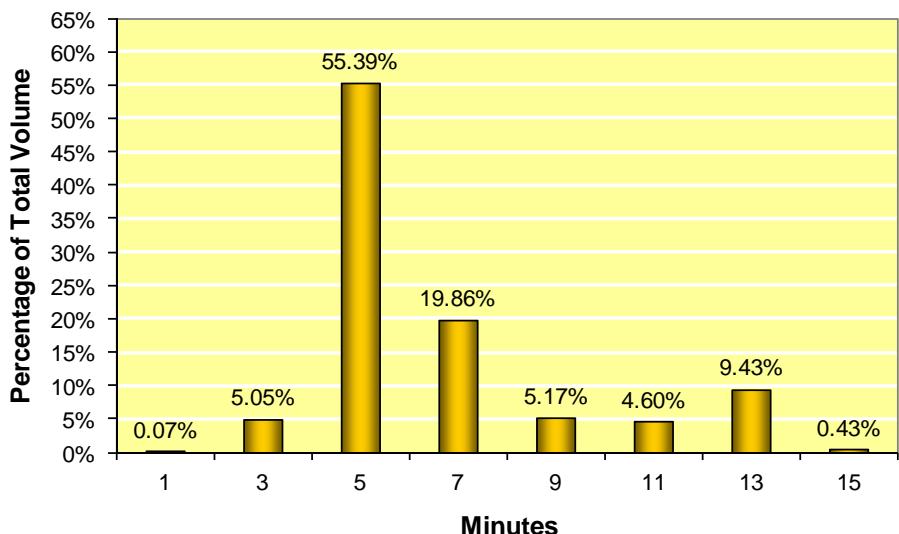


Figure 4-33: Filtration Time (minutes), maximum 15

## Water Separation Index—2011

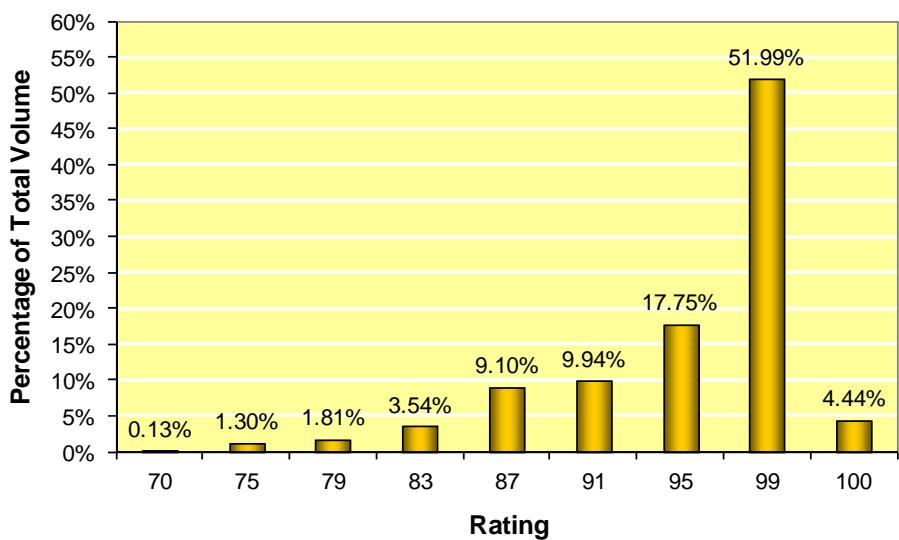


Figure 4-34: Water Separation Index (rating), minimum 70

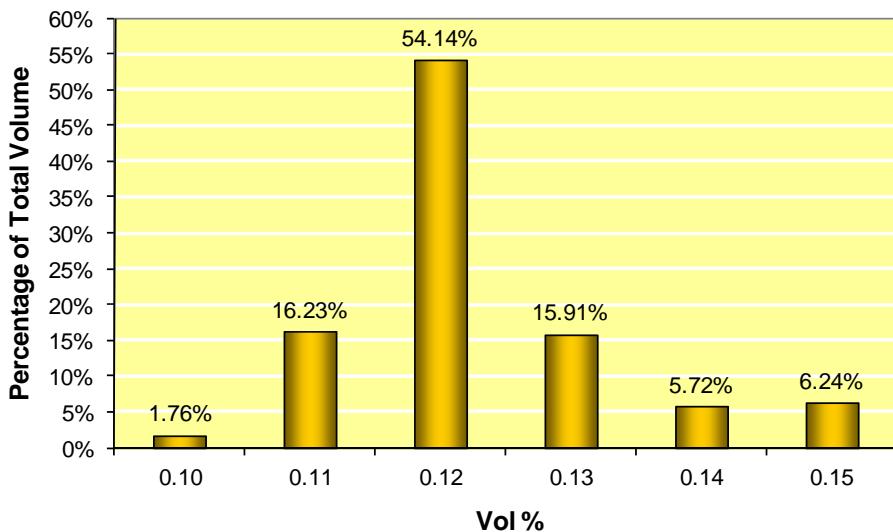
**Fuel System Icing Inhibitor (FSII)—2011**

Figure 4-35: Fuel System Icing Inhibitor (FSII) (vol %), minimum 0.10, maximum 0.15

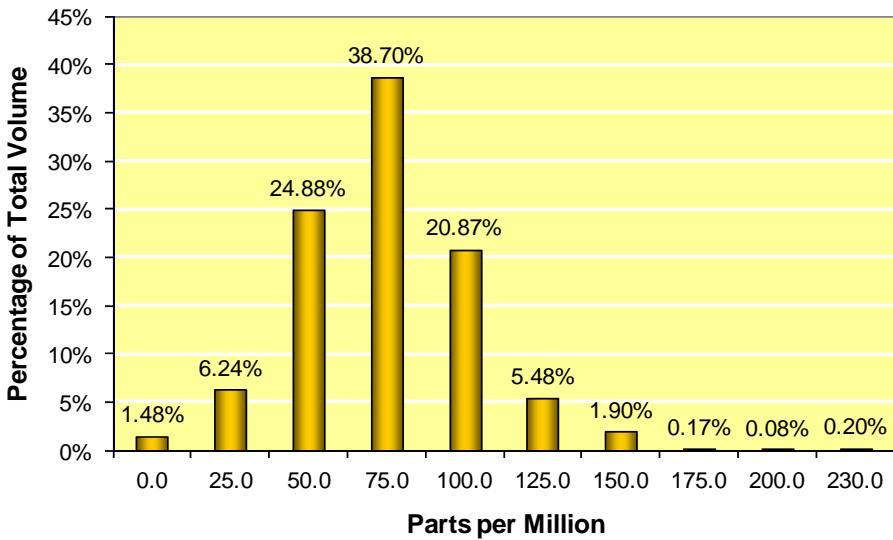
**Water Content—2011**

Figure 4-36: Water Content—2011

## Water Content—2011 (January–June)

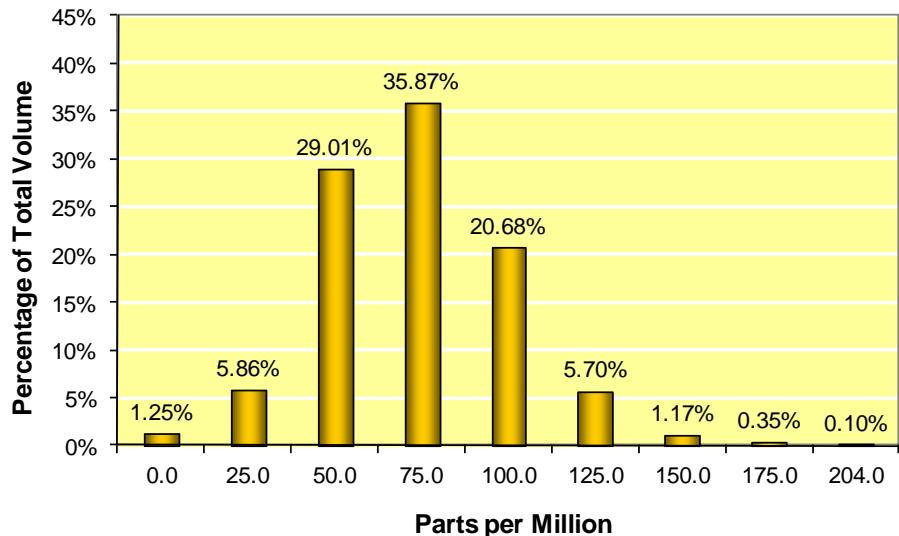


Figure 4-37: Water Content, January–June 2011

## Water Content—2011 (July–December)

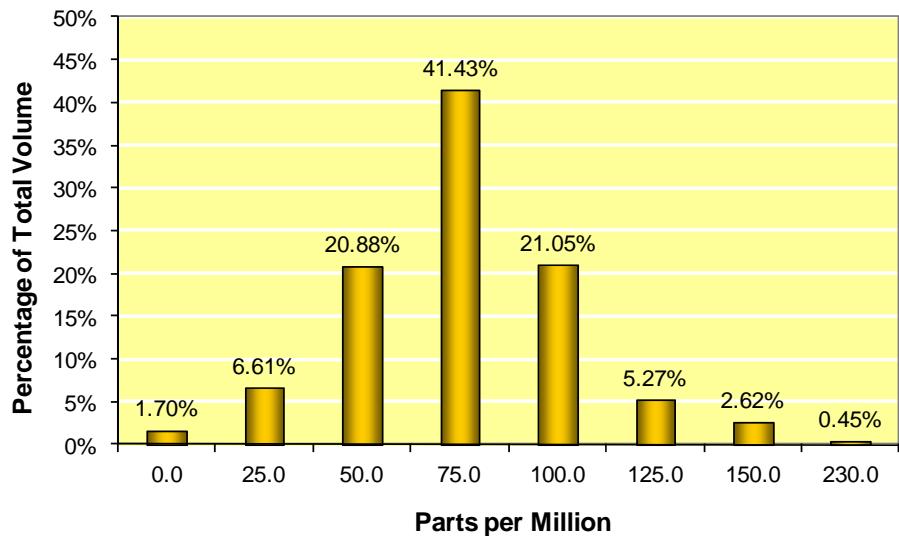


Figure 4-38: Water Content, July–December 2011



# JP5–2011 Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)			
Property	2011 Source Inputs		
	Region	Volume	Analysis
<b>Total Acid Number:</b> (mg KOH/g)	All	485.58	231
<b>Aromatics:</b> (vol %)	All	485.58	231
<b>Sulfur, Total:</b> (mass %)	All	485.58	231
<b>Sulfur, Mercaptan:</b> (mass %)	All	323.48	112
<b>Distillation Temperature:</b>			
Initial boiling point, (°C)	All	505.74	235
10% recovered, (°C)	All	505.74	235
20% recovered, (°C)	All	505.74	235
50% recovered, (°C)	All	505.74	235
90% recovered, (°C)	All	505.74	235
End point, (°C)	All	502.82	234
Residue, (vol %)	All	297.34	165
Loss, (vol %)	All	297.34	165
<b>Flash Point:</b> (°C)	All	505.74	235
<b>Density:</b> (kg/L @ 15 °C)	All	505.74	235
<b>Freezing Point:</b> (°C)	All	505.74	235
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)	All	485.58	231
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	All	483.48	230
<b>Cetane Index:</b> (calculated)	All	475.47	230
<b>Hydrogen Content:</b> (mass %)	All	432.24	206
<b>Smoke Point:</b> (mm)	All	482.22	230
<b>Thermal Stability:</b>			
Change in pressure drop, mm Hg @ 275 °C	All	465.18	226
<b>Existent Gum:</b> (mg/100 mL)	All	501.27	231
<b>Particulate Matter:</b> (mg/L)	All	505.74	235
<b>Filtration Time:</b> (minutes)	All	505.74	235
<b>MSEP:</b> (rating)	All	492.78	230
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	All	158.45	56

Table 5-1: Data Summary, MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44), 2011 Source Inputs

# JP5–2011 Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
Total Acid Number: (mg KOH/g)		0.015	0.0005	0.0110	0.0040	0.0038
Aromatics: (vol %)		25.0	15.3	24.2	18.97	19.07
Sulfur, Total: <sup>1</sup> (mass %)		0.30	0.000	0.290	0.074	0.083
Sulfur, Mercaptan: <sup>2</sup> (mass %)		0.002	0.0001	0.0020	0.0011	0.0011
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)		Report	132.0	194.5	169.9	164.5
10% recovered, <sup>3</sup> (°C)		205 <sup>(186)</sup>	168.0	203.0	189.9	186.3
20% recovered, (°C)		Report	181.0	218.0	198.1	195.4
50% recovered, (°C)		Report	199.0	253.0	215.7	214.8
90% recovered, (°C)		Report	218.2	278.0	243.0	245.1
End point, <sup>3</sup> (°C)		300 <sup>(330)</sup>	234.6	292.0	261.5	264.1
Residue, (vol %)		1.5	0.5	1.5	1.0	1.1
Loss, (vol %)		1.5	0.2	1.5	1.0	0.9
Flash Point: (°C)	60		60.0	74.0	64.4	64.3
Density: (kg/L @ 15 °C)	0.788	0.845	0.7966	0.8380	0.8177	0.8146
Freezing Point: (°C)		-46	-80.0	-46.0	-51.8	-51.7
Viscosity: (mm <sup>2</sup> /s @ -20 °C)		8.5	3.433	8.210	5.635	5.419
Heating Value, Heat of combustion: (MJ/kg)	42.6		42.900	45.050	43.114	43.152
Cetane Index: (calculated)		Report	36.7	48.5	43.5	44.3
Hydrogen Content: (mass %)	13.4		13.40	16.32	13.91	13.86
Smoke Point: (mm)	19.0		19.0	26.0	21.5	22.0
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		25	0.00	3.00	0.18	0.21
Existent Gum: (mg/100 mL)		7.0	0.0	3.0	1.00	1.09
Particulate Matter: (mg/L)		1.0	0.00	1.00	0.26	0.27
Filtration Time: (minutes)		15	2	9	4.12	4.02
MSEP: (rating)	70		70	99	90.1	88.3
Fuel System Icing Inhibitor (FSII): (vol %)	0.10	0.15	0.109	0.140	0.119	0.122

Table 5-2: Data Summary, MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44), 2011 Test Results

**Note 1:** The clause for procurement states a maximum of 0.20 mass % for sulfur, total, for JP5, but the specification limit for sulfur, total, is a maximum of 0.30 mass %.

**Note 2:** The sulfur, mercaptan limit, or negative doctor test result is acceptable to meet the specification requirement.

**Note 3:** Test method D2887 limits in parentheses (°C)

# JP5–2011 Regional Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Total Volume		0.48			
	Batch Analysis		14			
	Specification Limits		Region 2			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0030	0.0050	0.0044	0.0042
<b>Aromatics:</b> (vol %)		<b>25.0</b>	15.3	18.4	16.81	16.97
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.0006	0.1012	0.065	0.048
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	NR	NR	NR	NR
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)		<b>Report</b>	181.3	194.5	187.1	189.0
10% recovered, (°C)		<b>205<sup>(186)</sup></b>	197.3	202.6	199.4	199.9
20% recovered, (°C)		<b>Report</b>	200.8	204.5	203.0	203.1
50% recovered, (°C)		<b>Report</b>	209.7	214.2	212.0	211.9
90% recovered, (°C)		<b>Report</b>	228.6	236.1	232.6	232.7
End point, (°C)		<b>300<sup>(330)</sup></b>	248.0	256.5	251.5	252.4
Residue, (vol %)		<b>1.5</b>	1.0	1.3	1.1	1.1
Loss, (vol %)		<b>1.5</b>	0.7	1.0	0.9	0.9
<b>Flash Point:</b> (°C)	<b>60</b>		63.0	74.0	66.9	68.6
<b>Density:</b> (kg/L @ 15 °C)	<b>0.788</b>	<b>0.845</b>	0.8086	0.8142	0.8101	0.8107
<b>Freezing Point:</b> (°C)		<b>-46</b>	-51.8	-48.1	-49.3	-49.9
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	5.170	5.720	5.494	5.488
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	<b>42.6</b>		43.200	43.200	43.200	43.200
<b>Cetane Index:</b> (calculated)		<b>Report</b>	43.70	46.70	45.2	44.9
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		15.36	16.32	15.75	15.58
<b>Smoke Point:</b> (mm)	<b>19.0</b>		20.0	26.0	23.9	22.3
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	0.10	0.09	0.09
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.2	2.6	1.14	1.12
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.132	0.978	0.34	0.26
<b>Filtration Time:</b> (minutes)		<b>15</b>	3	6	4.50	4.53
<b>MSEP:</b> (rating)	<b>70</b>		71	96	82.0	81.7
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.109	0.129	0.116	0.117

Table 5-3: Region 2 Summary

# JP5—2011 Regional Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Total Volume		235.85			
	Batch Analysis		95			
	Specification Limits		Region 3			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0005	0.0080	0.0041	0.0039
<b>Aromatics:</b> (vol %)		<b>25.0</b>	15.7	22.2	19.09	19.19
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.010	0.165	0.095	0.109
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	0.0003	0.0018	0.0013	0.0013
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)	<b>Report</b>		132.0	188.0	152.7	146.6
10% recovered, (°C)	<b>205<sup>(186)</sup></b>		168.0	203.0	181.2	177.7
20% recovered, (°C)	<b>Report</b>		181.0	218.0	194.0	191.7
50% recovered, (°C)	<b>Report</b>		207.0	253.0	218.3	217.4
90% recovered, (°C)	<b>Report</b>		233.0	278.0	250.3	251.0
End point, (°C)	<b>300<sup>(330)</sup></b>		253.0	292.0	271.0	271.9
Residue, (vol %)	<b>1.5</b>		0.7	1.1	0.9	1.0
Loss, (vol %)	<b>1.5</b>		0.2	1.2	0.9	0.9
<b>Flash Point:</b> (°C)	<b>60</b>		61.0	69.0	65.3	65.5
<b>Density:</b> (kg/L @ 15 °C)	<b>0.788</b>	<b>0.845</b>	0.8037	0.8375	0.8172	0.8148
<b>Freezing Point:</b> (°C)		<b>-46</b>	-57.0	-46.4	-49.7	-49.1
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	4.346	8.210	5.626	5.372
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	<b>42.6</b>		42.900	45.050	43.133	43.167
<b>Cetane Index:</b> (calculated)	<b>Report</b>		39.20	48.15	44.5	45.1
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.47	14.50	13.93	13.98
<b>Smoke Point:</b> (mm)	<b>19.0</b>		19.0	24.0	21.6	22.0
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	1.00	0.09	0.06
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.0	3.0	0.96	1.04
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.00	0.53	0.15	0.16
<b>Filtration Time:</b> (minutes)		<b>15</b>	2	5	3.28	3.11
<b>MSEP:</b> (rating)	<b>70</b>		70	99	87.6	86.2
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	NR	NR	NR	NR

Table 5-4: Region 3 Summary

# JP5–2011 Regional Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Total Volume		99.90			
	Batch Analysis		79			
	Specification Limits		Region 5			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0010	0.0110	0.0037	0.0034
<b>Aromatics:</b> (vol %)		<b>25.0</b>	16.1	23.9	19.48	19.40
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.000	0.070	0.036	0.033
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	0.0001	0.0010	0.0007	0.0007
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)		<b>Report</b>	173.0	188.0	182.4	182.8
10% recovered, (°C)		<b>205<sup>(186)</sup></b>	193.0	202.0	197.8	198.2
20% recovered, (°C)		<b>Report</b>	200.0	208.0	203.9	204.1
50% recovered, (°C)		<b>Report</b>	212.0	228.0	218.3	218.3
90% recovered, (°C)		<b>Report</b>	233.0	255.0	241.3	241.2
End point, (°C)		<b>300<sup>(330)</sup></b>	249.0	280.0	257.6	257.6
Residue, (vol %)		<b>1.5</b>	0.5	1.2	1.0	1.0
Loss, (vol %)		<b>1.5</b>	0.2	1.5	1.0	1.0
<b>Flash Point:</b> (°C)	<b>60</b>		61.0	68.0	63.8	64.2
<b>Density:</b> (kg/L @ 15 °C)	<b>0.788</b>	<b>0.845</b>	0.8190	0.8380	0.8267	0.8269
<b>Freezing Point:</b> (°C)		<b>-46</b>	-62.0	-48.0	-54.2	-54.2
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	5.290	7.360	6.155	6.170
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	<b>42.6</b>		42.900	43.100	43.022	43.021
<b>Cetane Index:</b> (calculated)		<b>Report</b>	36.70	44.40	41.1	41.0
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.40	13.80	13.58	13.58
<b>Smoke Point:</b> (mm)	<b>19.0</b>		19.0	21.0	20.1	20.0
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	3.00	0.14	0.10
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.0	2.4	0.82	0.83
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.00	1.00	0.27	0.23
<b>Filtration Time:</b> (minutes)		<b>15</b>	4	7	4.35	4.33
<b>MSEP:</b> (rating)	<b>70</b>		89	99	95.7	95.4
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	NR	NR	NR	NR

Table 5-5: Region 5 Summary

# JP5—2011 Regional Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Total Volume		73.87			
	Batch Analysis		10			
	Specification Limits		Region 6			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0020	0.0020	0.0020	0.0020
<b>Aromatics:</b> (vol %)		<b>25.0</b>	16.8	17.0	16.93	16.94
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.008	0.010	0.009	0.009
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	NR	NR	NR	NR
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)	<b>Report</b>		172.0	180.1	175.2	175.2
10% recovered, (°C)	<b>205<sup>(186)</sup></b>		188.0	191.4	189.5	189.4
20% recovered, (°C)	<b>Report</b>		194.0	198.0	195.6	195.6
50% recovered, (°C)	<b>Report</b>		216.0	219.1	217.7	217.7
90% recovered, (°C)	<b>Report</b>		260.0	263.0	261.5	261.7
End point, (°C)	<b>300<sup>(330)</sup></b>		273.0	282.2	277.5	278.1
Residue, (vol %)	<b>1.5</b>		1.0	1.4	1.2	1.2
Loss, (vol %)	<b>1.5</b>		0.4	1.0	0.7	0.6
<b>Flash Point:</b> (°C)	<b>60</b>		61.0	64.0	62.7	62.8
<b>Density:</b> (kg/L @ 15 °C)	<b>0.788</b>	<b>0.845</b>	0.8069	0.8096	0.8085	0.8082
<b>Freezing Point:</b> (°C)		<b>-46</b>	-51.0	-46.0	-48.7	-48.9
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	5.953	6.572	6.297	6.292
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	<b>42.6</b>		43.272	43.298	43.282	43.284
<b>Cetane Index:</b> (calculated)	<b>Report</b>		47.20	48.40	47.7	47.7
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.90	14.20	14.10	14.10
<b>Smoke Point:</b> (mm)	<b>19.0</b>		24.0	25.0	24.3	24.3
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	0.00	0.00	0.00
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	1.0	2.0	1.43	1.42
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.26	0.87	0.39	0.44
<b>Filtration Time:</b> (minutes)		<b>15</b>	4	8	5.29	5.52
<b>MSEP:</b> (rating)	<b>70</b>		76	98	86.7	85.1
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.110	0.130	0.121	0.122

Table 5-6: Region 6 Summary

# JP5–2011 Regional Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Total Volume		62.38			
	Batch Analysis		20			
	Specification Limits		Region 7			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0020	0.0090	0.0048	0.0043
<b>Aromatics:</b> (vol %)		<b>25.0</b>	15.5	24.2	18.85	19.44
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.001	0.290	0.076	0.056
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	0.0001	0.0020	0.0006	0.0005
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)	Report		175.0	187.0	181.8	182.2
10% recovered, (°C)			205 <sup>(186)</sup>	188.7	196.3	191.9
20% recovered, (°C)	Report		192.3	199.0	195.3	196.0
50% recovered, (°C)	Report		199.0	210.0	205.0	206.1
90% recovered, (°C)	Report		218.2	236.0	228.5	230.1
End point, (°C)	Report		234.6	256.0	245.9	247.3
Residue, (vol %)	1.5		0.8	1.5	1.1	1.2
Loss, (vol %)	1.5		0.2	1.2	0.8	0.8
<b>Flash Point:</b> (°C)	<b>60</b>		61.0	68.0	63.4	63.2
<b>Density:</b> (kg/L @ 15 °C)	<b>0.788</b>	<b>0.845</b>	0.7992	0.8201	0.8090	0.8118
<b>Freezing Point:</b> (°C)		<b>-46</b>	-80.0	-46.0	-58.6	-63.0
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	3.433	5.414	4.632	4.732
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	<b>42.6</b>		43.000	43.300	43.172	43.151
<b>Cetane Index:</b> (calculated)	Report		40.70	48.50	43.3	42.9
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.44	14.09	13.79	13.70
<b>Smoke Point:</b> (mm)	<b>19.0</b>		20.0	25.0	22.2	22.1
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	3.00	0.56	0.87
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.9	3.0	1.44	1.43
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.20	0.80	0.44	0.46
<b>Filtration Time:</b> (minutes)		<b>15</b>	2	9	4.75	4.36
<b>MSEP:</b> (rating)	<b>70</b>		70	99	87.8	85.3
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.110	0.140	0.125	0.130

Table 5-7: Region 7 Summary

# JP5—2011 Regional Data Summary

MIL-DTL-5624 Turbine Fuel, Aviation, Grade JP5 (NATO Code F-44)						
Property	Total Volume		56.64			
	Batch Analysis		20			
	Specification Limits		Region 8			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0030	0.0070	0.0042	0.0044
<b>Aromatics:</b> (vol %)		<b>25.0</b>	16.8	21.5	18.62	19.12
<b>Sulfur, Total:</b> (mass %)		<b>0.30</b>	0.080	0.216	0.157	0.149
<b>Sulfur, Mercaptan:</b> (mass %)		<b>0.002</b>	0.0005	0.0016	0.0010	0.0010
<b>Distillation Temperature:</b>						
Initial boiling point, (°C)		<b>Report</b>	170.9	180.0	176.6	177.4
10% recovered, (°C)		<b>205<sup>(186)</sup></b>	187.1	196.3	190.9	190.6
20% recovered, (°C)		<b>Report</b>	190.5	201.6	194.9	194.2
50% recovered, (°C)		<b>Report</b>	201.8	215.8	205.9	204.8
90% recovered, (°C)		<b>Report</b>	225.0	243.9	230.8	229.0
End point, (°C)		<b>300<sup>(330)</sup></b>	242.1	260.1	249.9	249.4
Residue, (vol %)		<b>1.5</b>	1.0	1.5	1.1	1.0
Loss, (vol %)		<b>1.5</b>	0.9	1.5	1.0	1.0
<b>Flash Point:</b> (°C)	<b>60</b>		60.0	63.0	62.1	62.1
<b>Density:</b> (kg/L @ 15 °C)	<b>0.788</b>	<b>0.845</b>	0.7966	0.8129	0.8022	0.8005
<b>Freezing Point:</b> (°C)		<b>-46</b>	-50.0	-46.6	-48.5	-48.5
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.5</b>	4.229	5.590	4.527	4.425
<b>Heating Value, Heat of combustion:</b> (MJ/kg)	<b>42.6</b>		43.159	43.304	43.222	43.228
<b>Cetane Index:</b> (calculated)		<b>Report</b>	44.60	47.50	46.0	46.2
<b>Hydrogen Content:</b> (mass %)	<b>13.4</b>		13.65	13.94	13.76	13.76
<b>Smoke Point:</b> (mm)	<b>19.0</b>		22.0	25.0	23.8	24.0
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	0.00	1.00	0.48	0.44
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.2	2.8	1.16	1.06
<b>Particulate Matter:</b> (mg/L)		<b>1.0</b>	0.30	0.89	0.45	0.43
<b>Filtration Time:</b> (minutes)		<b>15</b>	3	8	5.85	5.56
<b>MSEP:</b> (rating)	<b>70</b>		76	97	88.6	90.0
<b>Fuel System Icing Inhibitor (FSII):</b> (vol %)	<b>0.10</b>	<b>0.15</b>	0.110	0.120	0.117	0.116

Table 5-8: Region 8 Summary

# JP5—Assessment Summary

## **Overview:**

In 2011, 238 reported analyses, representing 529.11 million U.S. gallons of JP5, were processed by Regions 2, 3, 5, 6, 7, and 8. This represents a decrease from the 292 reported JP5 analyses from 2010, but an increase from the 482.33 million U.S. gallons of JP5 queried from the PQIS in 2010.

## **Significant Trending:**

**Sulfur, Total.** The weighted mean decreased 0.019 mass % from 2010 to 2011 after increasing 0.057 mass % from 2003 to 2010.

**Distillation, 10% Recovered.** The weighted mean increased 3.9 °C from 2008 to 2011.

**Distillation, End Point.** Aside from a slight increase from 2008 to 2009, the weighted mean decreased 6.7 °C from 2004 to 2011.

**Flash Point.** The weighted mean increased 1.7 °C from 2009 to 2011.

**Freezing Point.** The weighted mean decreased 2.7 °C from 2009 to 2011.

**Smoke Point.** The weighted mean decreased 1.0 millimeter from 2008 to 2011.

## **JP5 Observations:**

All batches met specification requirements in 2011.

For **Sulfur, Total**, the clause for procurement states a maximum of 0.20 mass % for JP5, but the specification limit for sulfur, total, is a maximum of 0.30 mass %.

For **MSEP**, all JP5 batches met specification requirements. The impact of additives provides for a wide variation (see Table 5-9). Batches were not separated by type of additives or group of additives for this reporting.

Product	Additives <sup>1</sup>	MSEP Rating, min
JP-4 and JP-5	Antioxidant (AO), Metal Deactivator (MDA)	90
JP-4 and JP-5	AO, MDA, and FSII	85
JP-4 and JP-5	AO, MDA, and Corrosion Inhibitor/Lubricity Improver (CI/LI)	80
JP-4 and JP-5	AO, MDA, CI/LI, and FSII	70

Table 5-9: JP-4 and JP-5 Additives and Associated MSEP Ratings

**Note 1:** Samples submitted for specification conformance testing shall contain the same additives present in the refinery batch. Regardless of which minimum the refiner elects to meet, the refiner shall report the MSEP rating on a laboratory hand blend of the fuel with all additives required by the specification.

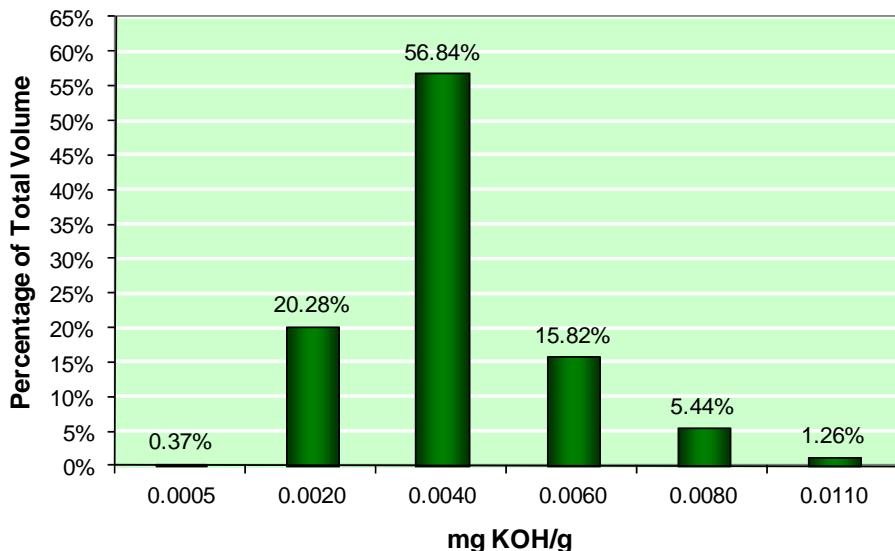
**Total Acid Number—2011**

Figure 5-1: Total Acid Number (mg KOH/g), maximum 0.015

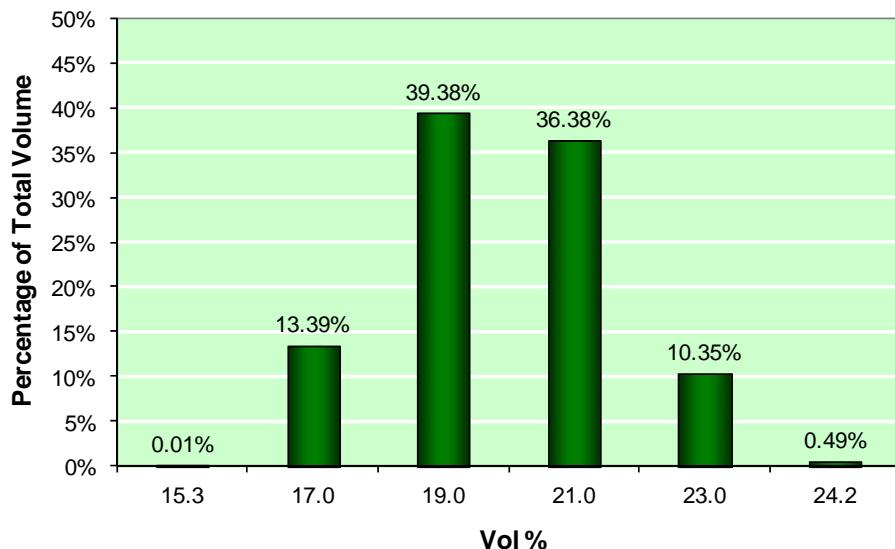
**Aromatics—2011**

Figure 5-2: Aromatics (vol %), maximum 25.0

# JP5 Data

## Sulfur, Total—2011

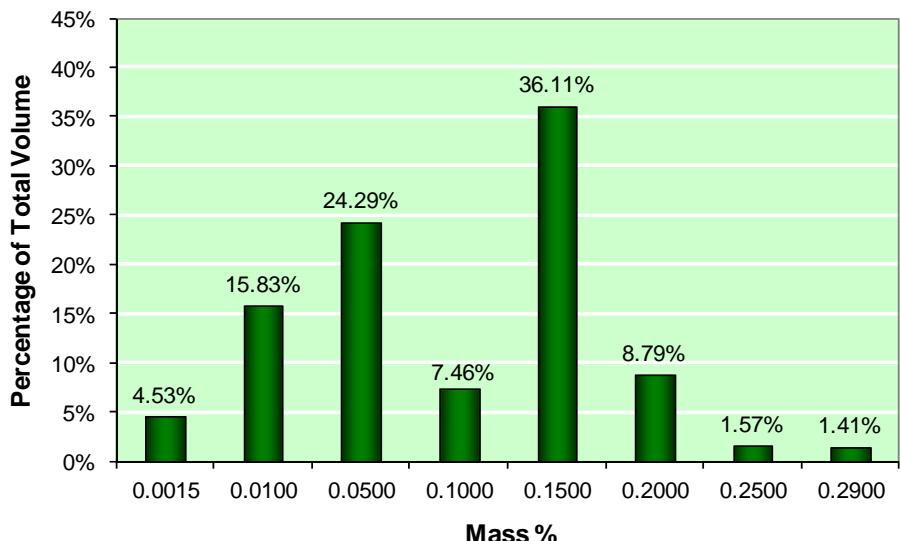


Figure 5-3: Sulfur, Total (mass %), maximum 0.30

## Sulfur, Total 11-Year Trend—Weighted Mean

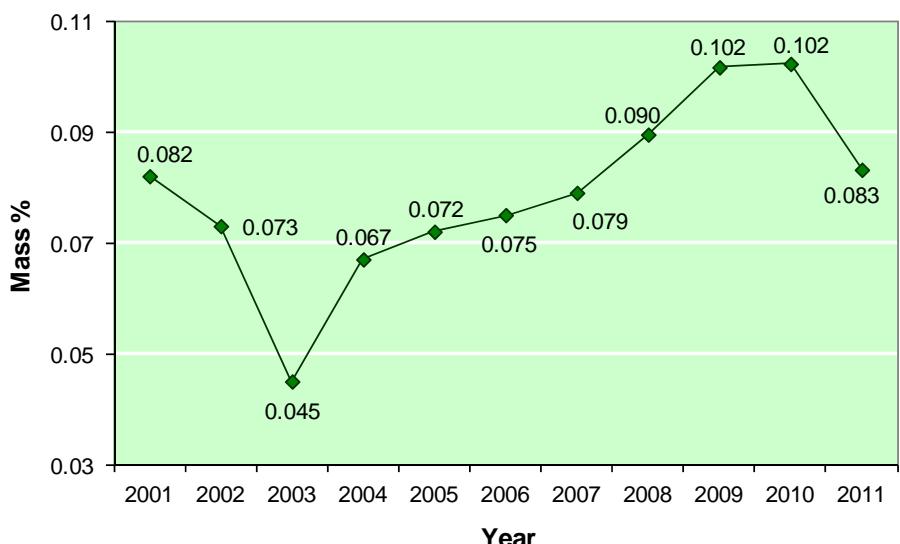


Figure 5-4: Sulfur, Total (mass %), 11-Year Trend, maximum 0.30

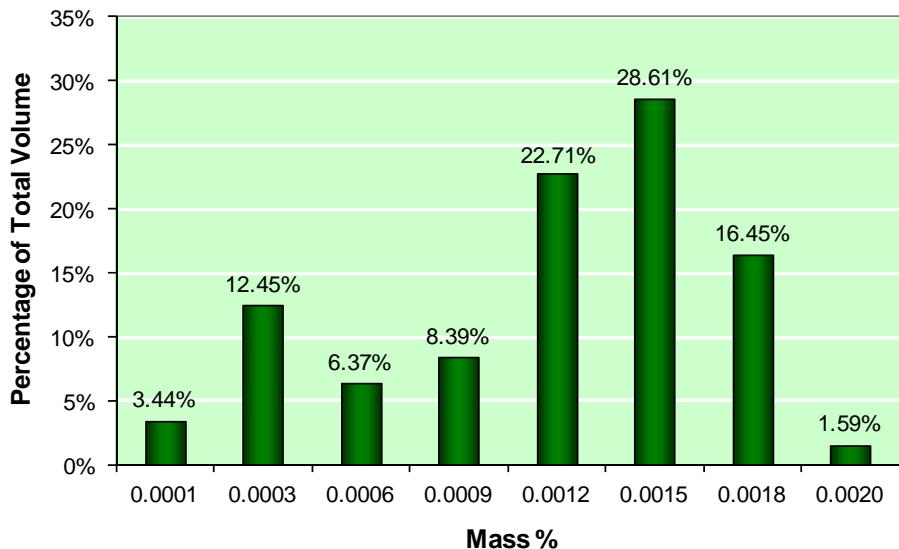
**Sulfur, Mercaptan—2011**

Figure 5-5: Sulfur, Mercaptan (mass %), maximum 0.002

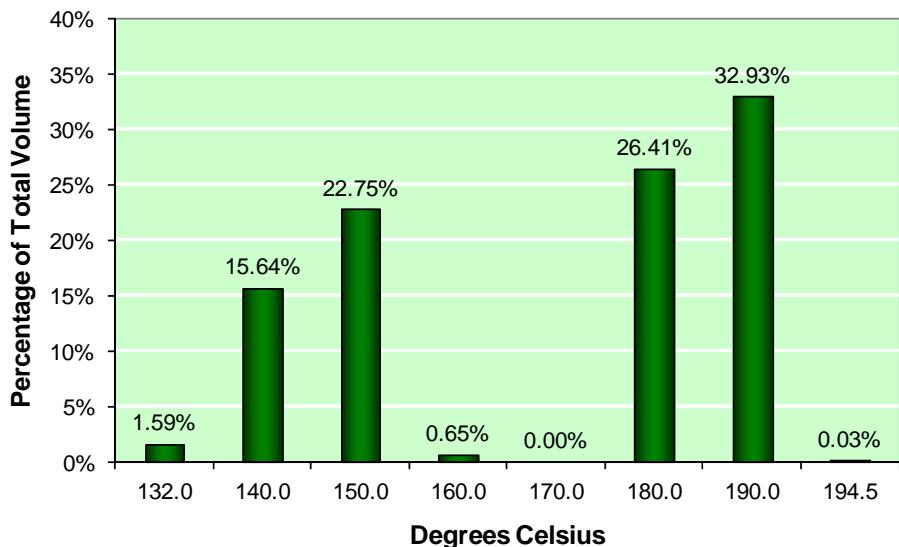
**Distillation Initial Boiling Point—2011**

Figure 5-6: Distillation Initial Boiling Point (°C), Report

# JP5 Data

## Distillation 10% Recovered—2011

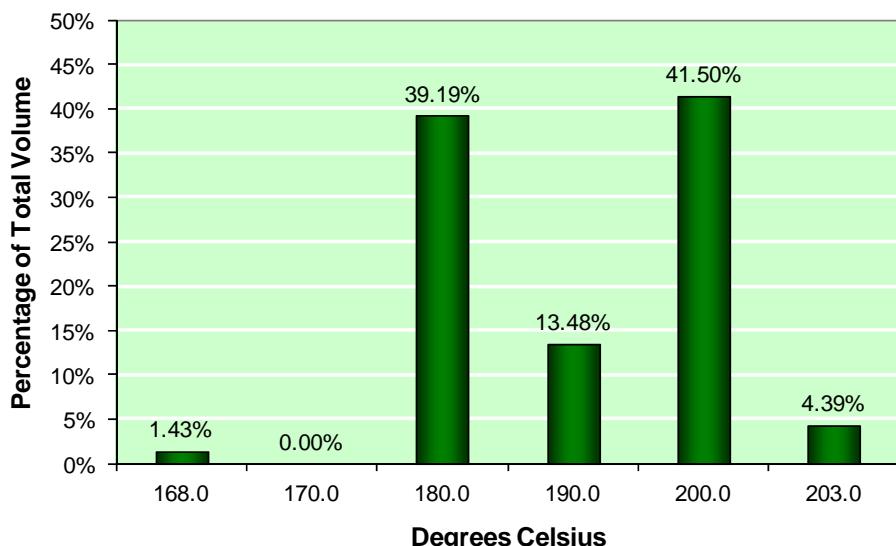


Figure 5-7: Distillation 10% Recovered ( $^{\circ}\text{C}$ ), maximum  $205^{(186)}$  (method D2887 limits in parentheses,  $^{\circ}\text{C}$ )

## Distillation 10% Recovered 11-Year Trend—Weighted Mean

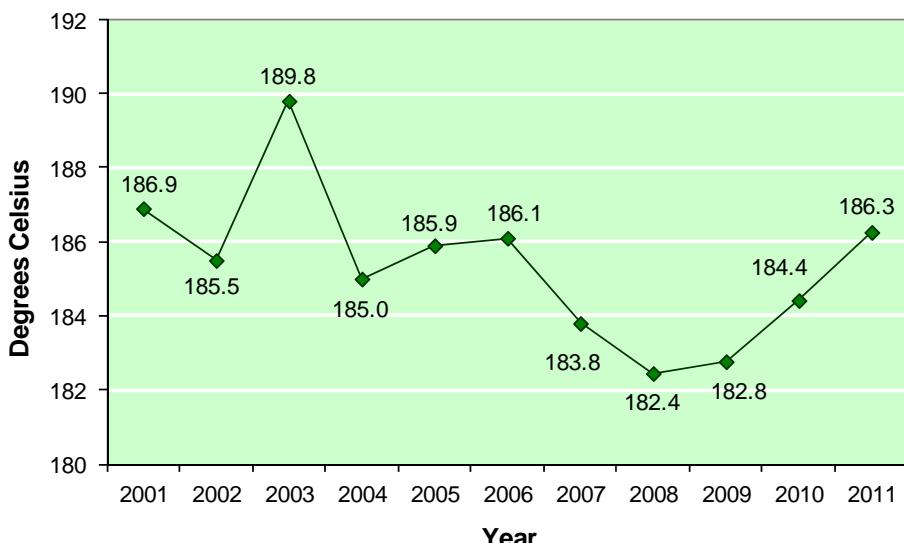


Figure 5-8: Distillation 10% Recovered ( $^{\circ}\text{C}$ ), 11-Year Trend, maximum  $205^{(186)}$  (method D2887 limits in parentheses,  $^{\circ}\text{C}$ )

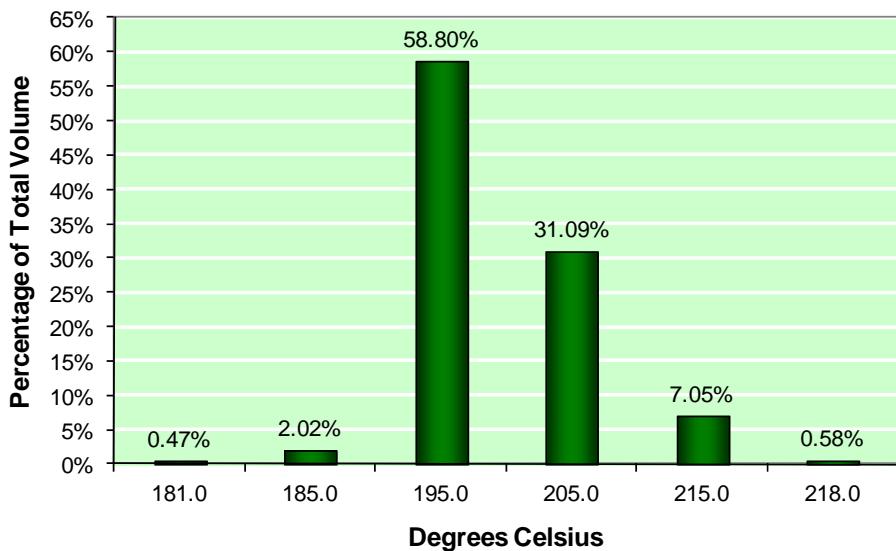
**Distillation 20% Recovered—2011**

Figure 5-9: Distillation 20% Recovered (°C), Report

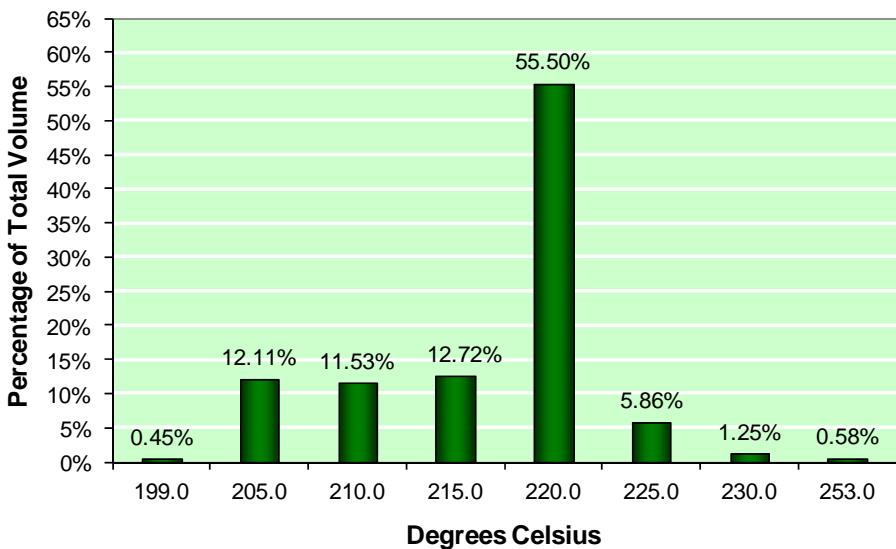
**Distillation 50% Recovered—2011**

Figure 5-10: Distillation 50% Recovered (°C), Report

# JP5 Data

Distillation 90% Recovered—2011

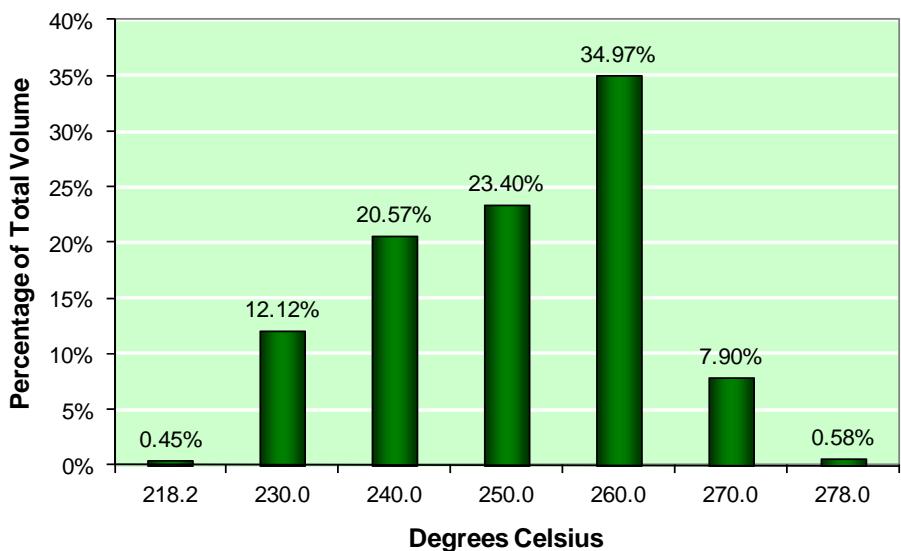


Figure 5-11: Distillation 90% Recovered (°C), Report



## Distillation End Point—2011

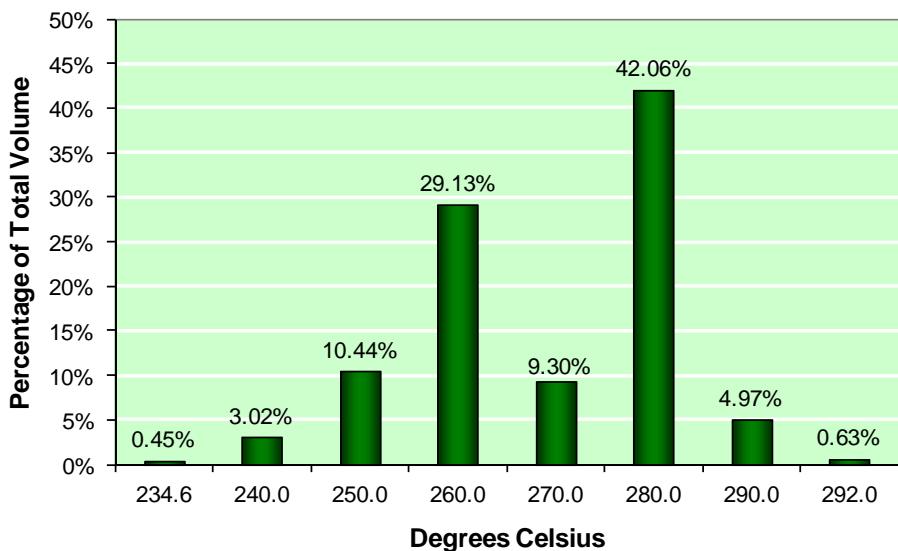


Figure 5-12: Distillation End Point (°C), maximum 300<sup>(330)</sup> (method D2887 limits in parentheses, °C)

## Distillation End Point 11-Year Trend—Weighted Mean

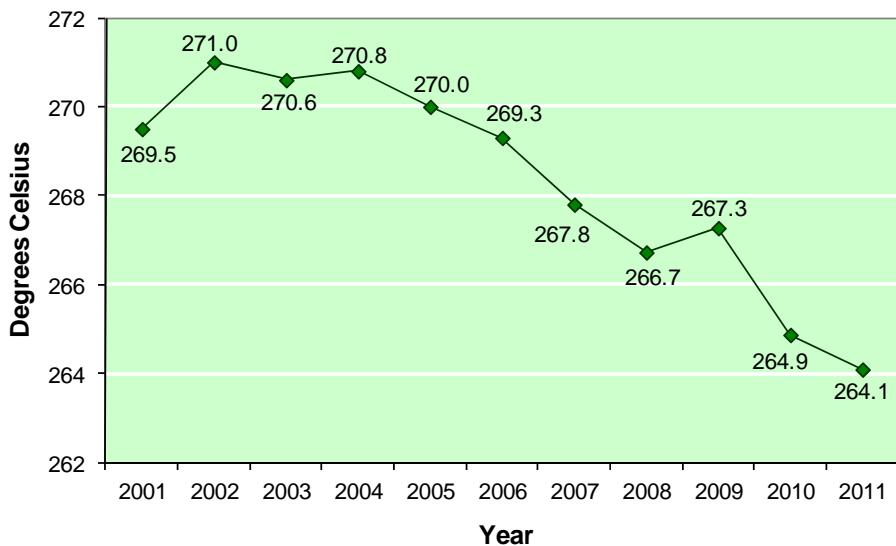


Figure 5-13: Distillation End Point (°C), 11-Year Trend, maximum 300<sup>(330)</sup> (method D2887 limits in parentheses, °C)

# JP5 Data

## Distillation Residue—2011

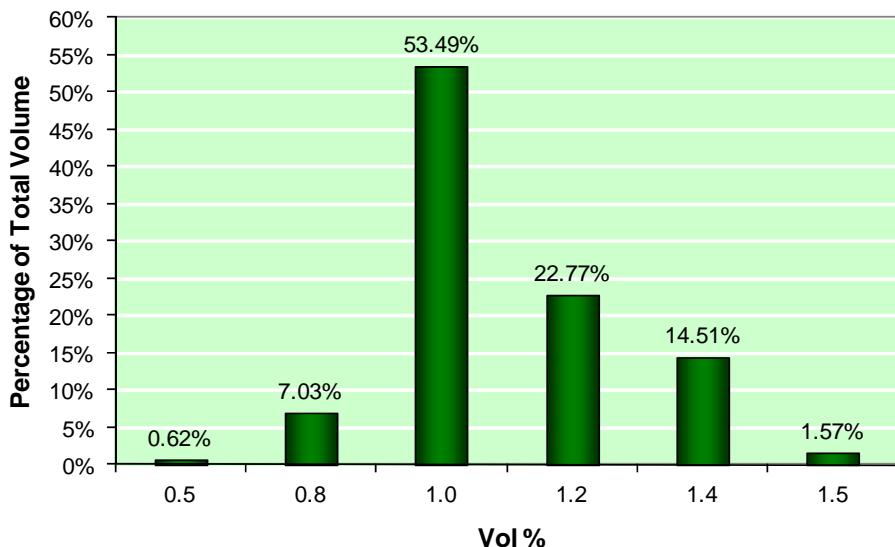


Figure 5-14: Distillation Residue (vol %), maximum 1.5

## Distillation Loss—2011

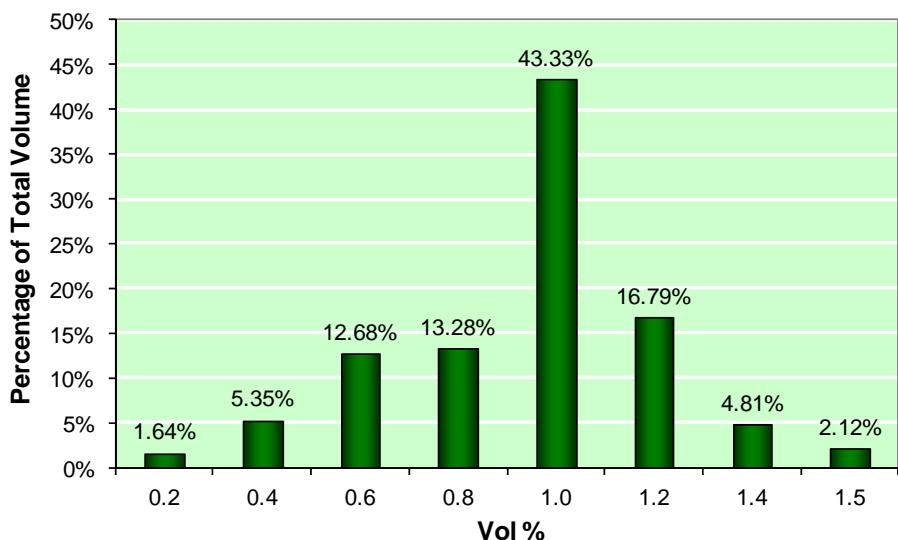


Figure 5-15: Distillation Loss (vol %), maximum 1.5

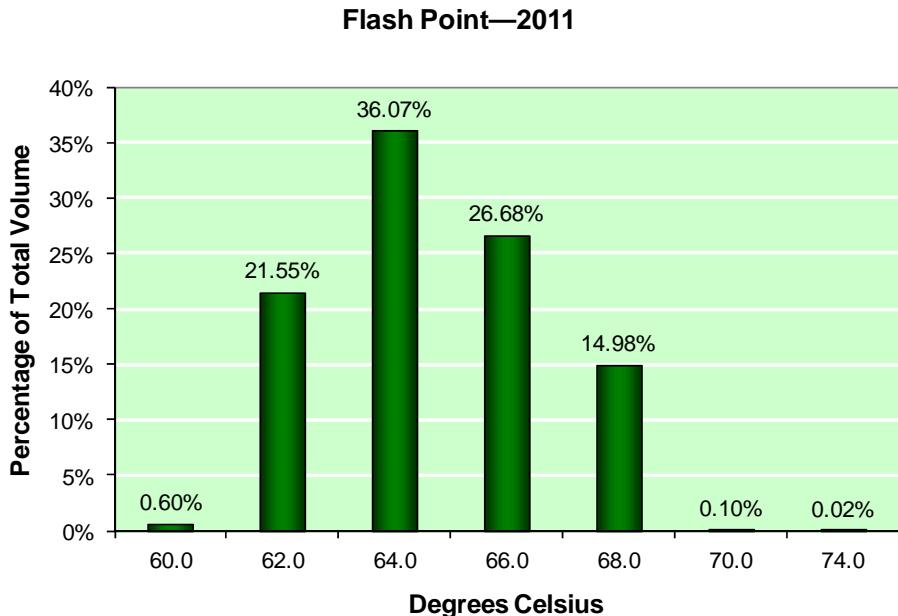


Figure 5-16: Flash Point (°C), minimum 60

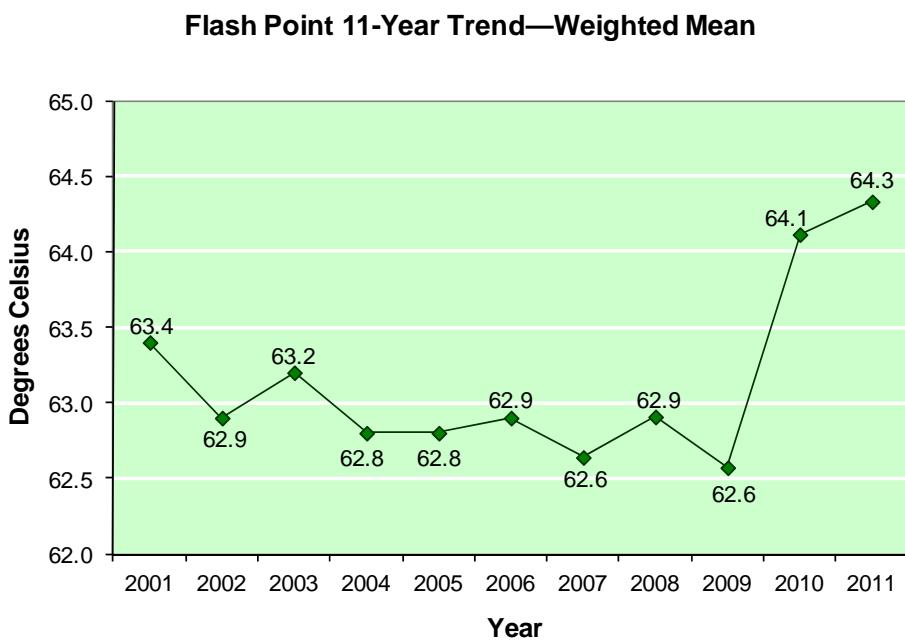


Figure 5-17: Flash Point (°C), 11-Year Trend, minimum 60

# JP5 Data

## Density—2011

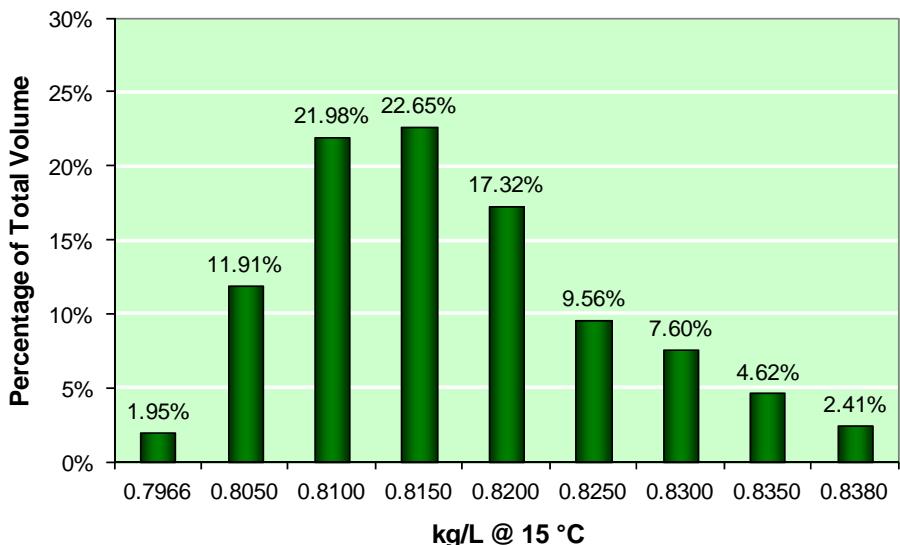


Figure 5-18: Density (kg/L @ 15 °C), minimum 0.788, maximum 0.845

## Density 11-Year Trend—Weighted Mean

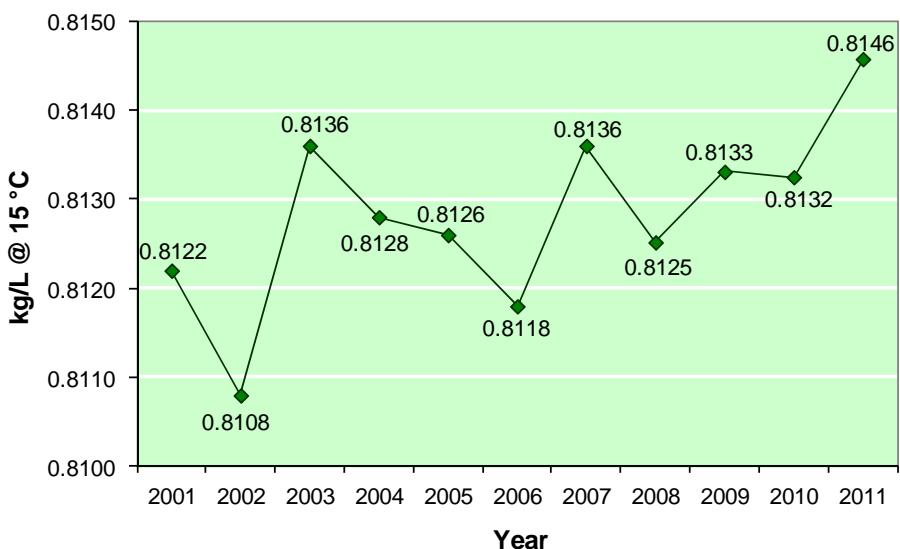


Figure 5-19: Density (kg/L @ 15 °C), 11-Year Trend, minimum 0.788, maximum 0.845

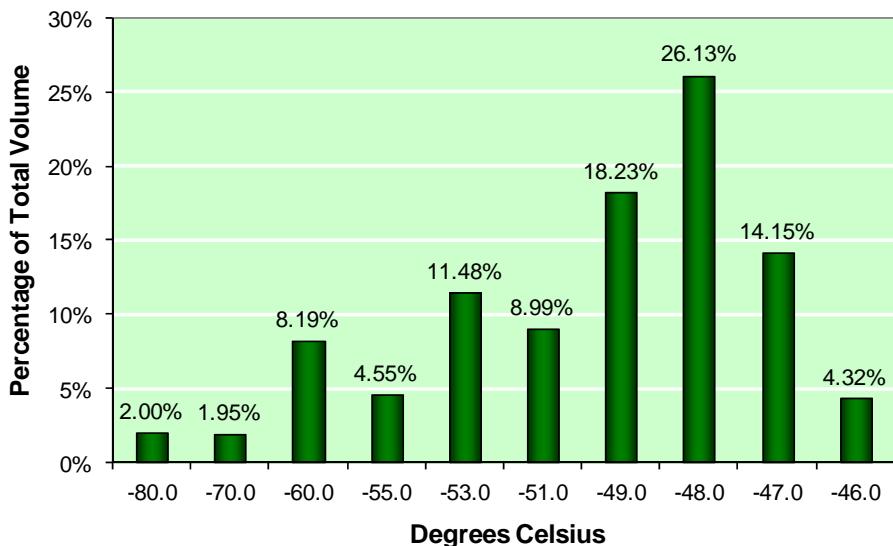
**Freezing Point—2011**

Figure 5-20: Freezing Point (°C), maximum –46

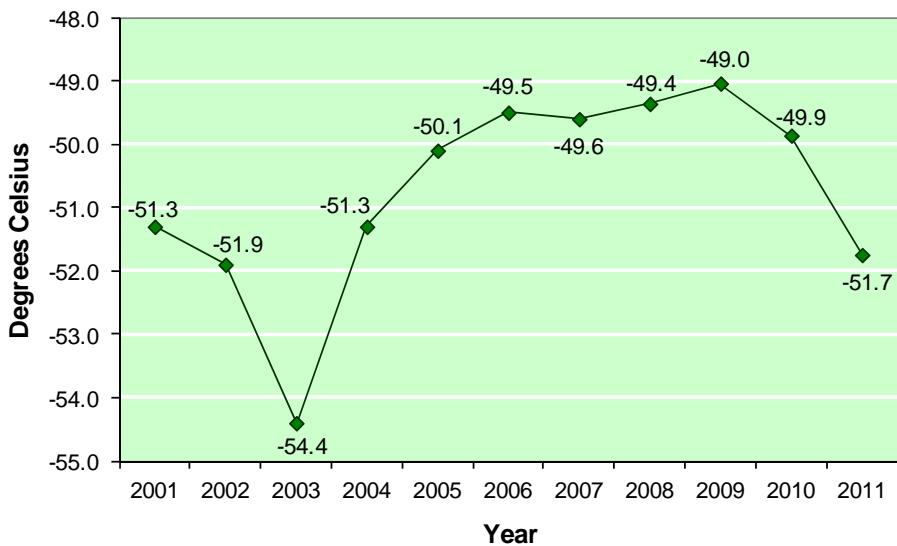
**Freezing Point 11-Year Trend—Weighted Mean**

Figure 5-21: Freezing Point (°C), 11-Year Trend, maximum –46

# JP5 Data

## Viscosity—2011

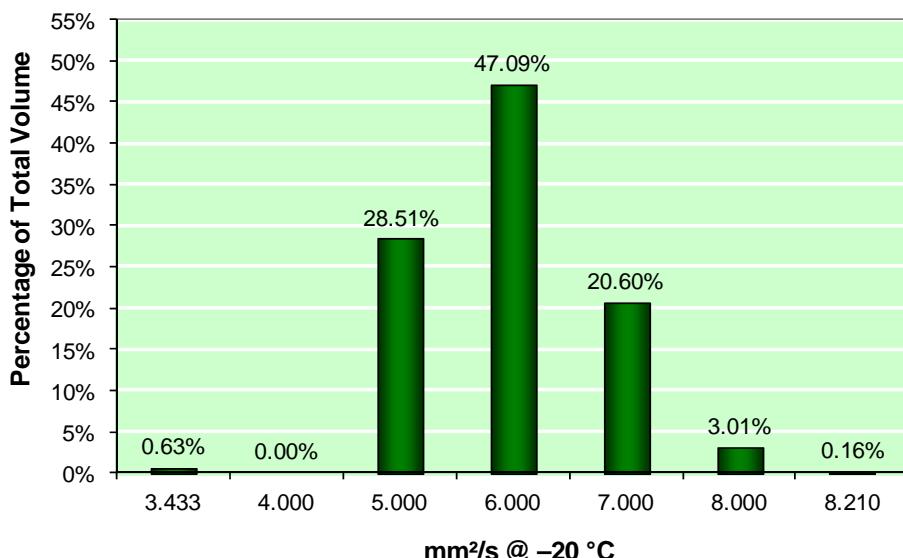


Figure 5-22: Viscosity (mm<sup>2</sup>/s @ -20 °C), maximum 8.5

## Heat Value, Heat of Combustion—2011

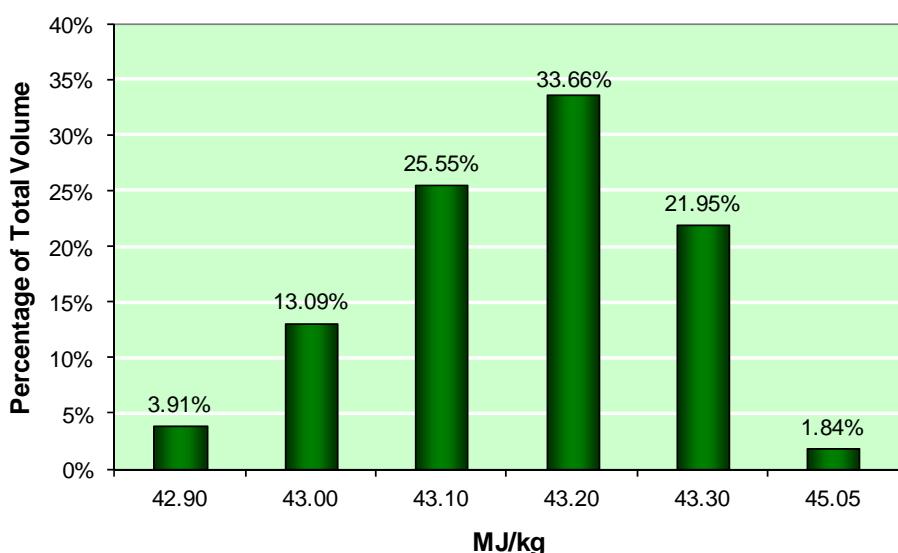


Figure 5-23: Heat Value, Heat of Combustion (MJ/kg), minimum 42.6

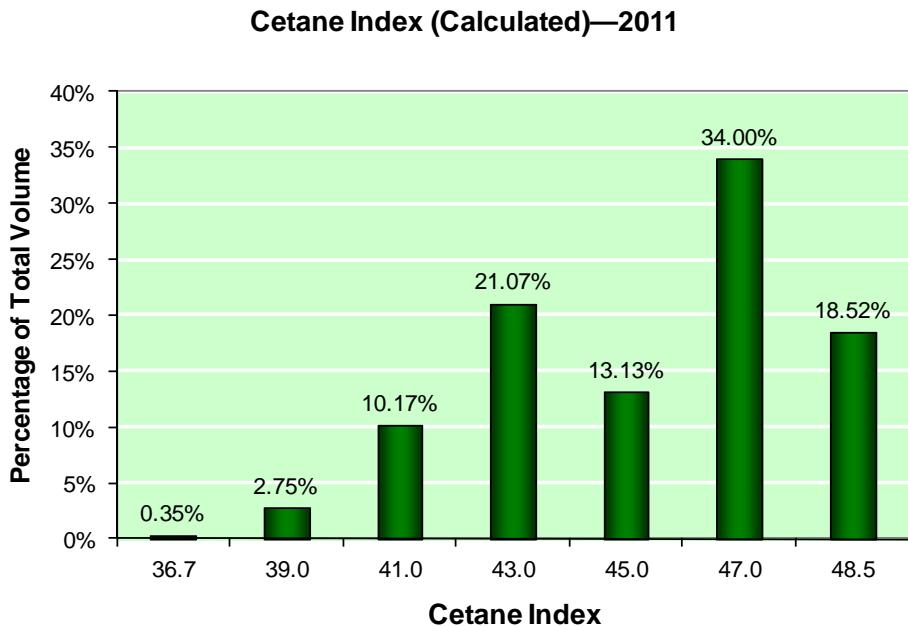


Figure 5-24: Cetane Index (Calculated), Report

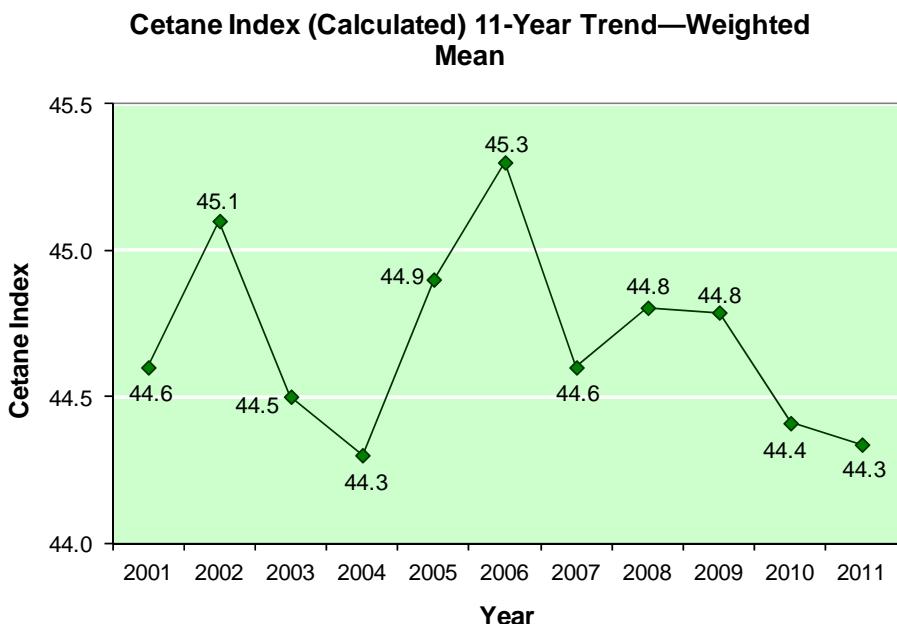


Figure 5-25: Cetane Index (Calculated), 11-Year Trend, Report

# JP5 Data

## Hydrogen Content—2011

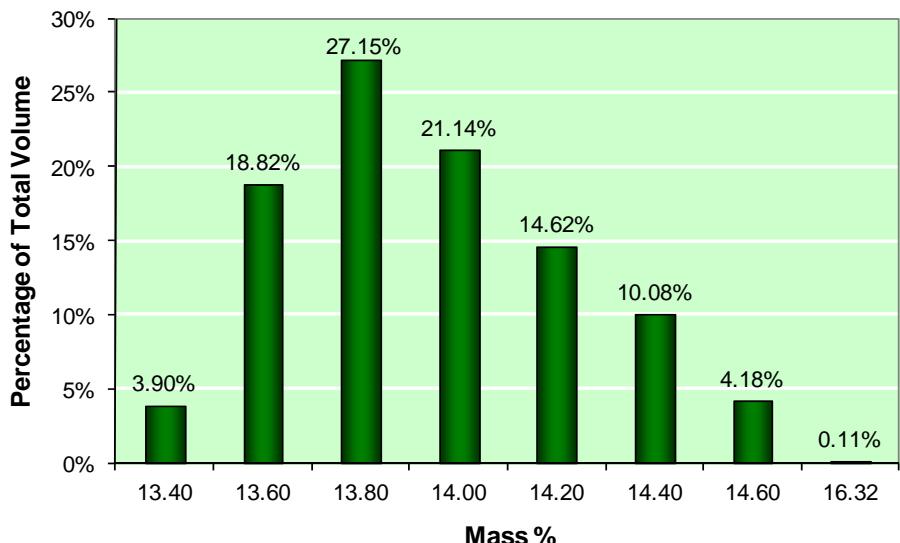


Figure 5-26: Hydrogen Content (mass %), minimum 13.4

## Hydrogen Content 11-Year Trend—Weighted Mean

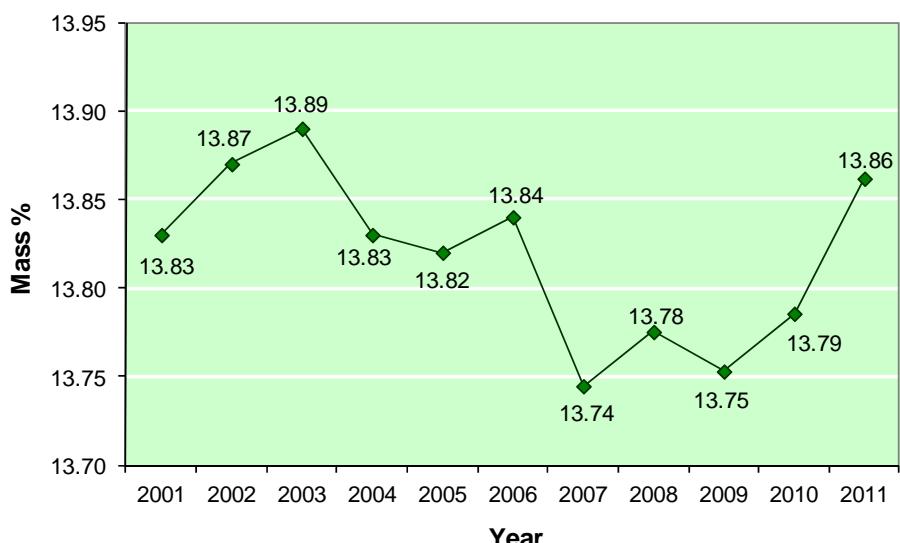


Figure 5-27: Hydrogen Content (mass %), 11-Year Trend, minimum 13.4

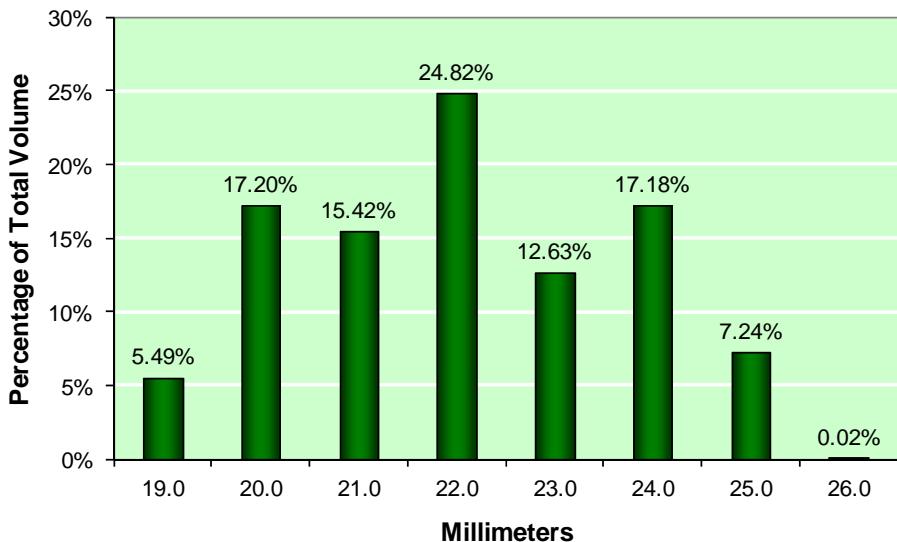
**Smoke Point—2011**

Figure 5-28: Smoke Point (mm), minimum 19.0

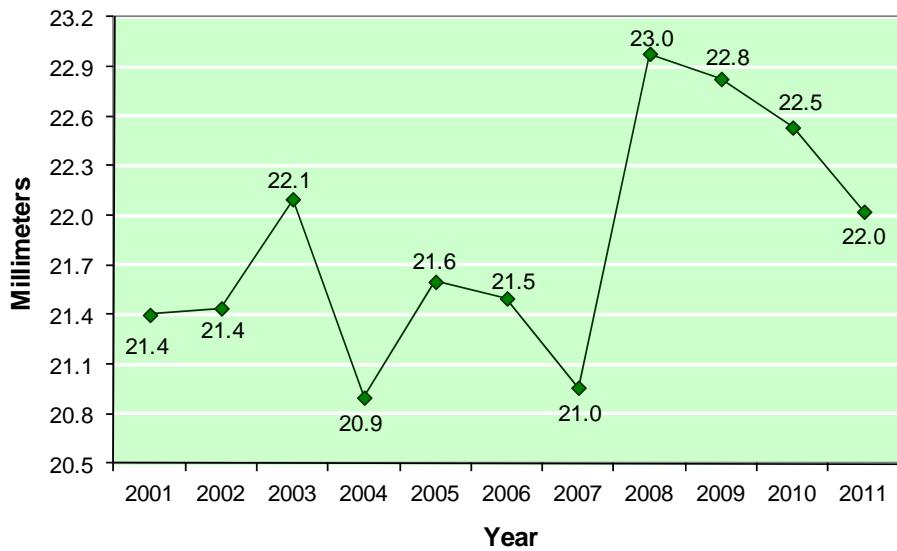
**Smoke Point 11-Year Trend—Weighted Mean**

Figure 5-29: Smoke Point (mm), 11-Year Trend, minimum 19.0

# JP5 Data

## Thermal Stability (JFTOT @ 275 °C)—2011

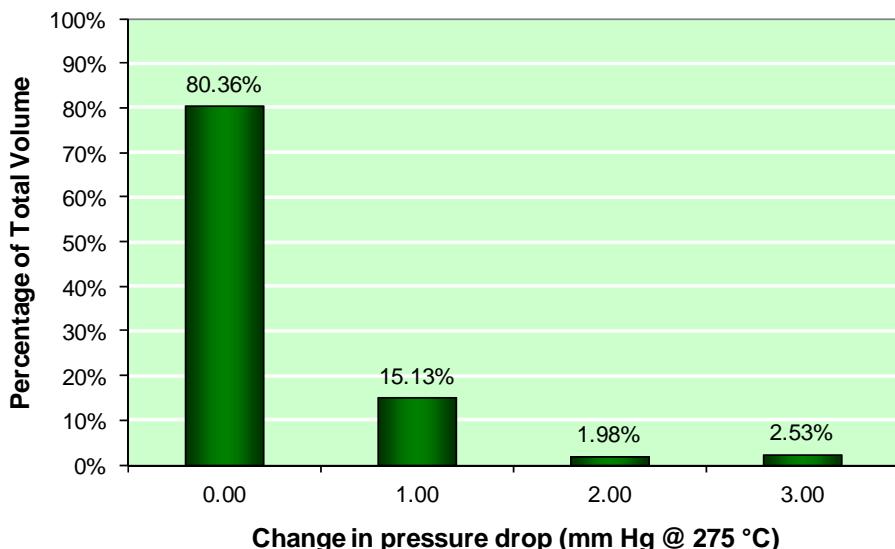


Figure 5-30: Thermal Stability, Change in Pressure Drop (mm Hg @ 275 °C), maximum 25

## Existent Gum—2011

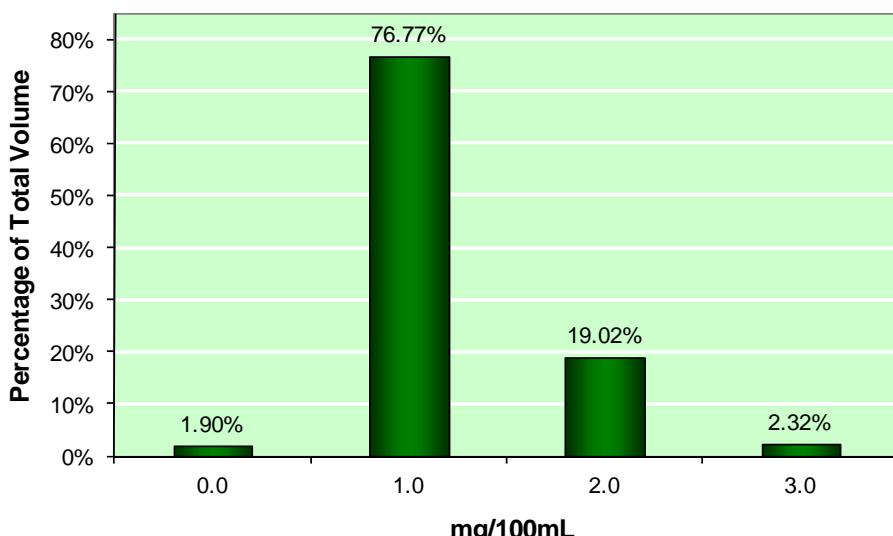


Figure 5-31: Existent Gum (mg/100 mL), maximum 7.0

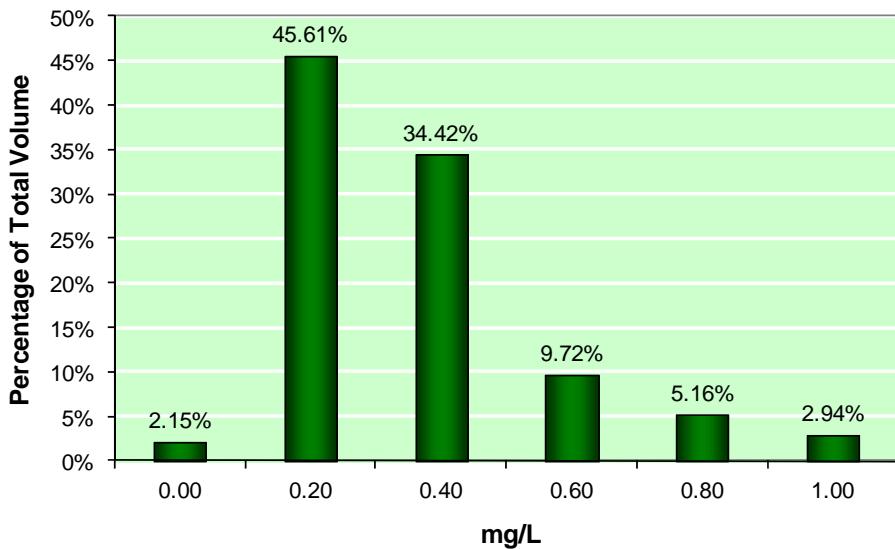
**Particulate Matter—2011**

Figure 5-32: Particulate Matter (mg/L), maximum 1.0

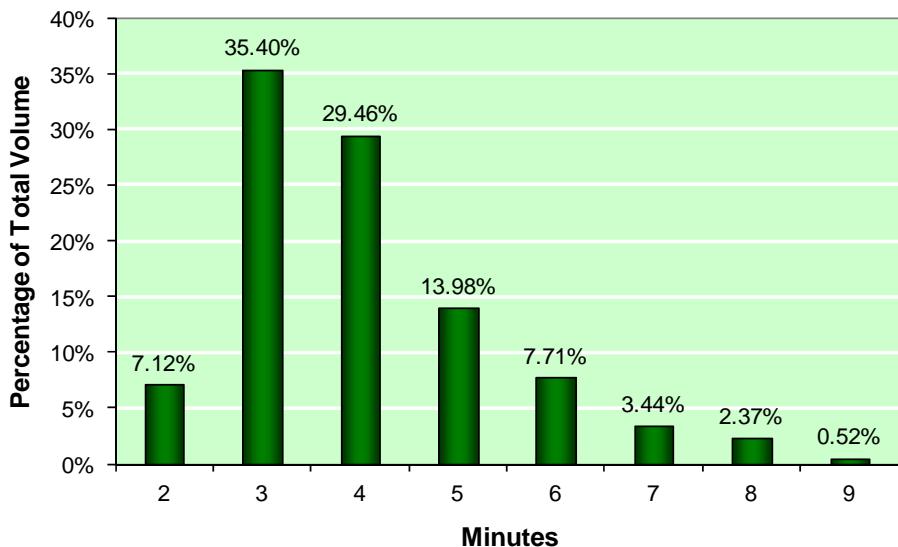
**Filtration Time—2011**

Figure 5-33: Filtration Time (minutes), maximum 15

# JP5 Data

## Micro Separometer (MSEP)—2011

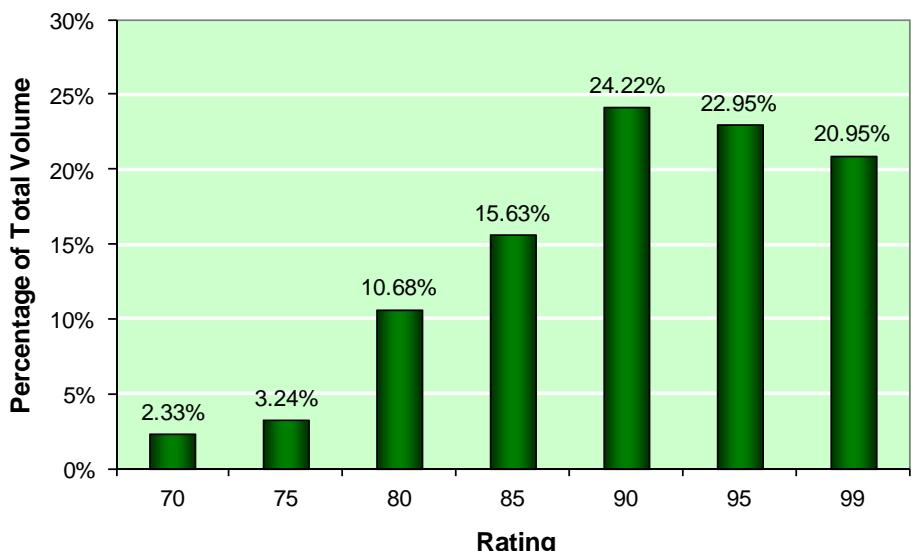


Figure 5-34: MSEP (rating), minimum 70

## Fuel System Icing Inhibitor—2011

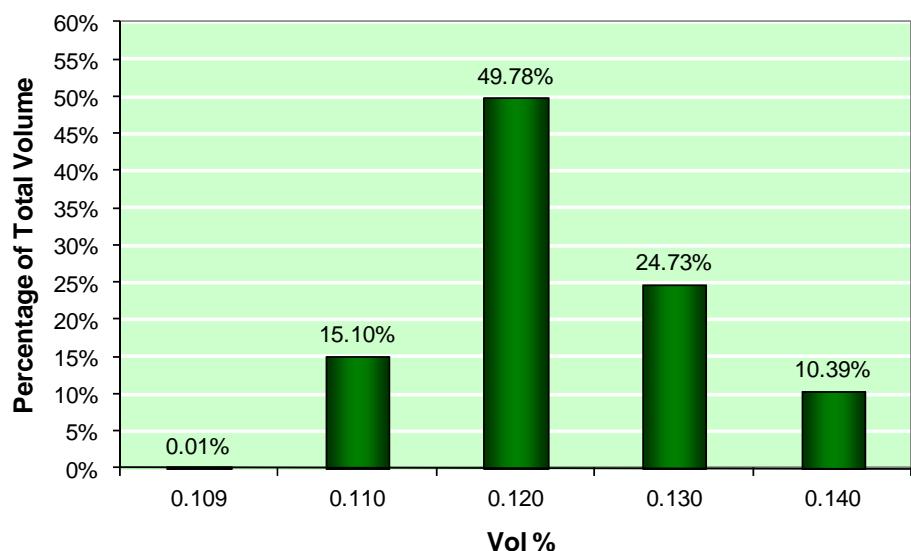


Figure 5-35: Fuel System Icing Inhibitor (FSII) (vol %), minimum 0.10, maximum 0.15



# JA1–2011 Data Summary

Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91			
Property	2011 Source Inputs		
	Region	Volume	Analysis
<b>Total Acid Number:</b> (mg KOH/g)	All	418.03	222
<b>Aromatics:</b> (vol %)	All	378.26	204
<b>Sulfur Mercaptan:</b> (mass %)	All	407.79	215
<b>Sulfur, Total:</b> (mass %)	All	399.20	212
<b>Distillation:</b>			
Initial Boiling Point (IBP), (°C)	All	467.90	248
10% recovered, (°C)	All	467.90	248
50% recovered, (°C)	All	467.90	248
90% recovered, (°C)	All	467.90	248
Final Boiling Point (FBP), (°C)	All	467.90	248
Residue, (vol %)	All	435.26	237
Loss, (vol %)	All	448.79	238
<b>Flash Point:</b> (°C)	All	465.79	246
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	All	454.65	241
<b>Freezing Point:</b> (°C)	All	354.66	192
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)	All	399.20	212
<b>Net Heat of Combustion:</b> (MJ/kg)	All	418.03	223
<b>Smoke Point:</b> (mm)	All	418.03	222
<b>Naphthalene:</b> (vol %)	All	112.88	164
<b>Thermal Stability:</b>			
Change in pressure drop, mm Hg @ 275 °C	All	NR	NR
Change in pressure drop, mm Hg @ 260 °C	All	339.06	202
<b>Existent Gum:</b> (mg/100 mL)	All	409.94	214
<b>Water Separation Index:</b> (rating)	All	438.32	239

Table 6-1: Data Summary, Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91, 2011 Source Inputs

# JAI—2011 Data Summary

Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0007	0.0140	0.0031	0.0048
<b>Aromatics:</b> (vol %)		<b>25.0</b>	12.70	24.60	17.79	18.25
<b>Sulfur Mercaptan:<sup>1</sup></b> (mass %)		<b>0.003</b>	0.0000	0.0030	0.0010	0.0013
<b>Sulfur, Total:</b> (mass %)		<b>0.3</b>	0.0001	0.2960	0.093	0.158
<b>Distillation:</b>						
Initial Boiling Point (IBP), (°C)		<b>Report</b>	138.0	164.0	150.6	147.8
10% recovered, (°C)			205.0	156.9	181.0	170.3
50% recovered, (°C)		<b>Report</b>	174.0	209.0	197.1	194.9
90% recovered, (°C)			194.0	247.9	236.0	239.3
Final Boiling Point (FBP), (°C)		<b>300.0</b>	216.0	280.0	260.9	263.3
Residue, (vol %)		1.5	0.6	1.5	1.2	1.1
Loss, (vol %)		1.5	0.1	1.5	0.5	0.7
<b>Flash Point:</b> (°C)	<b>38.0</b>		38.0	50.0	43.2	41.9
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	<b>775.0</b>	<b>840.0</b>	785.7	810.1	799.4	796.2
<b>Freezing Point:</b> (°C)		<b>-47</b>	-66.00	-47.00	-51.66	-50.68
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	1.656	5.193	3.905	3.751
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.80</b>		43.000	43.383	43.249	43.250
<b>Smoke Point:<sup>2</sup></b> (mm)	<b>25.0</b>		19.00	26.00	23.52	24.38
<b>Naphthalene:</b> (vol %)		<b>3</b>	0.22	2.50	1.00	1.46
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	NR	NR	NR	NR
Change in pressure drop, mm Hg @ 260 °C			0.00	3.00	1.22	0.68
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.60	6.00	1.37	1.85
<b>Water Separation Index:<sup>3</sup></b> (rating)	<b>70</b>		70	100	94.3	96.5

Table 6-2: Data Summary, Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91, 2011 Test Results

**Note 1:** Either the sulfur mercaptan limit or a negative doctor test result is acceptable to meet the specification requirement.

**Note 2:** When the smoke point result is below 25 mm, the product is acceptable so long as the naphthalene content is below 3.0 percent and the smoke point is above the minimum of 19 mm.

**Note 3:** The minimum MSEP rating with SDA is 70. The minimum MSEP rating without SDA is 85.

# JA1–2011 Regional Data Summary

Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91						
Property	Total Volume		210.36			
	Batch Analysis		25			
	Specification Limits		Region 6			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0010	0.0114	0.0039	0.0049
<b>Aromatics:</b> (vol %)		<b>25.0</b>	17.00	20.77	18.33	18.43
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.003</b>	0.0004	0.0021	0.0012	0.0011
<b>Sulfur, Total:</b> (mass %)		<b>0.3</b>	0.0516	0.2075	0.154	0.145
<b>Distillation:</b>						
Initial Boiling Point (IBP), (°C)		<b>Report</b>	143.7	155.4	147.7	147.9
10% recovered, (°C)		<b>205.0</b>	159.0	172.0	165.7	165.5
50% recovered, (°C)		<b>Report</b>	185.0	200.0	194.2	193.9
90% recovered, (°C)		<b>Report</b>	229.0	246.2	240.5	239.7
Final Boiling Point (FBP), (°C)		<b>300.0</b>	250.0	275.0	263.6	263.2
Residue, (vol %)		<b>1.5</b>	0.6	1.5	1.1	1.1
Loss, (vol %)		<b>1.5</b>	0.2	1.3	0.7	0.7
<b>Flash Point:</b> (°C)	<b>38.0</b>		38.0	44.0	40.4	40.8
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	<b>775.0</b>	<b>840.0</b>	785.7	796.7	792.7	792.8
<b>Freezing Point:</b> (°C)		<b>-47</b>	-54.40	-48.30	-50.72	-51.02
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.2534	4.580	3.747	3.786
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.80</b>		43.186	43.338	43.287	43.284
<b>Smoke Point:</b> (mm)	<b>25.0</b>		25.00	25.00	25.00	25.00
<b>Naphthalene:</b> (vol %)		<b>3</b>	NR	NR	NR	NR
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C		<b>25</b>	NR	NR	NR	NR
Change in pressure drop, mm Hg @ 260 °C			0.00	1.00	0.05	0.02
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	0.60	4.40	1.81	1.95
<b>Water Separation Index:</b> (rating)	<b>70</b>		86	100	97.7	97.5

Table 6-3: Region 6 Summary

# JAI-2011 Regional Data Summary

Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91						
Property	Total Volume		257.54			
	Batch Analysis		222			
	Specification Limits		Region 7			
	Min	Max	Min	Max	Mean	Wt Mean
Total Acid Number: (mg KOH/g)		0.015	0.0007	0.0140	0.0030	0.0047
Aromatics: (vol %)		25.0	12.70	24.60	17.75	18.07
Sulfur Mercaptan: (mass %)		0.003	0.0000	0.0030	0.0010	0.0015
Sulfur, Total: (mass %)		0.3	0.0001	0.2960	0.086	0.169
<b>Distillation:</b>						
Initial Boiling Point (IBP), (°C)	Report		138.0	164.0	150.9	147.8
10% recovered, (°C)	205.0		156.9	181.0	170.8	168.2
50% recovered, (°C)	Report		174.0	209.0	197.5	195.8
90% recovered, (°C)	Report		194.0	247.9	235.7	239.0
Final Boiling Point (FBP), (°C)	300.0		222.0	280.0	260.7	263.5
Residue, (vol %)	1.5		0.8	1.5	1.2	1.2
Loss, (vol %)	1.5		0.1	1.5	0.5	0.6
Flash Point: (°C)	38.0		39.0	50.0	43.5	42.9
Density: (kg/m³ @ 15 °C)	775.0		840.0	787.6	810.1	800.2
Freezing Point: (°C)	-47		-66.00	-47.00	-51.80	-50.18
Viscosity: (mm²/s @ -20 °C)	8.0		1.656	5.193	3.927	3.720
Net Heat of Combustion: (MJ/kg)	42.80		43.000	43.383	43.244	43.223
Smoke Point: (mm)	25.0		19.00	26.00	23.36	23.87
Naphthalene: (vol %)	3		0.22	2.50	1.00	1.46
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C	25		NR	NR	NR	NR
Change in pressure drop, mm Hg @ 260 °C			0.00	3.00	1.35	1.40
Existent Gum: (mg/100 mL)	7.0		1.00	6.00	1.31	1.75
Water Separation Index: (rating)	70		70	100	94.0	95.7

Table 6-4: Region 7 Summary

# JA1–2011 Regional Data Summary

Jet A-1 Turbine Fuel, Aviation, Defence Standard 91-91						
Property	Total Volume		NR			
	Batch Analysis		1			
	Specification Limits		Region 8			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Total Acid Number:</b> (mg KOH/g)		<b>0.015</b>	0.0010	0.0010	0.0010	NR
<b>Aromatics:</b> (vol %)		<b>25.0</b>	13.80	13.80	13.80	NR
<b>Sulfur Mercaptan:</b> (mass %)		<b>0.003</b>	0.0017	0.0017	0.0017	NR
<b>Sulfur, Total:</b> (mass %)		<b>0.3</b>	0.1200	0.1200	0.120	NR
<b>Distillation:</b>						
Initial Boiling Point (IBP), (°C)		<b>Report</b>	151.0	151.0	151.0	NR
10% recovered, (°C)		<b>205.0</b>	172.0	172.0	172.0	NR
50% recovered, (°C)		<b>Report</b>	189.0	189.0	189.0	NR
90% recovered, (°C)		<b>Report</b>	204.0	204.0	204.0	NR
Final Boiling Point (FBP), (°C)		<b>300.0</b>	216.0	216.0	216.0	NR
Residue, (vol %)		<b>1.5</b>	1.0	1.0	1.0	NR
Loss, (vol %)		<b>1.5</b>	1.0	1.0	1.0	NR
<b>Flash Point:</b> (°C)	<b>38.0</b>		44.0	44.0	44.0	NR
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	<b>775.0</b>	<b>840.0</b>	795.1	795.1	795.1	NR
<b>Freezing Point:</b> (°C)		<b>-47</b>	-51.50	-51.50	-51.50	NR
<b>Viscosity:</b> (mm <sup>2</sup> /s @ -20 °C)		<b>8.0</b>	3.373	3.373	3.373	NR
<b>Net Heat of Combustion:</b> (MJ/kg)	<b>42.80</b>		43.310	43.310	43.310	NR
<b>Smoke Point:</b> (mm)	<b>25.0</b>		22.00	22.00	22.00	NR
<b>Naphthalene:</b> (vol %)		<b>3</b>	0.54	0.54	0.54	NR
<b>Thermal Stability:</b>						
Change in pressure drop, mm Hg @ 275 °C			NR	NR	NR	NR
Change in pressure drop, mm Hg @ 260 °C		<b>25</b>	1.00	1.00	1.00	NR
<b>Existent Gum:</b> (mg/100 mL)		<b>7.0</b>	3.10	3.10	3.10	NR
<b>Water Separation Index:</b> (rating)	<b>70</b>		89	89	89.0	NR

Table 6-5: Region 8 Summary

# JA1—Assessment Summary

## ***Overview:***

JA1 was first featured in the 2004 report because of increasing annual procurements. In 2011, 248 reported analyses, representing 467.90 million U.S. gallons of JA1, were processed by Regions 6, 7, and 8. This was an increase from the 93 reported JA1 analyses and the 314.95 million U.S. gallons of JA1 queried from the PQIS in 2010.

## ***Trending:***

**Total Acid Number.** The weighted mean increased 0.0025 mg KOH/g from 2009 to 2011.

**Sulfur, Total.** The weighted mean increased 0.064 mass % from 2010 to 2011.

**Flash Point.** The weighted mean increased 1.2 °C from 2007 to 2011.

**Net Heat of Combustion.** The weighted mean decreased 0.14 MJ/kg from 2005 to 2011.

**Existent Gum.** Aside from a slight decrease from 2009 to 2010, the weighted mean increased 1.26 mg/100 mL from 2006 to 2011.

## ***JA1 Observations:***

All batches met specification requirements for 2011.

The minimum rating for **Water Separation Index** with SDA is 70. The minimum Water Separation Index rating without SDA is 85.



## Total Acid Number—2011

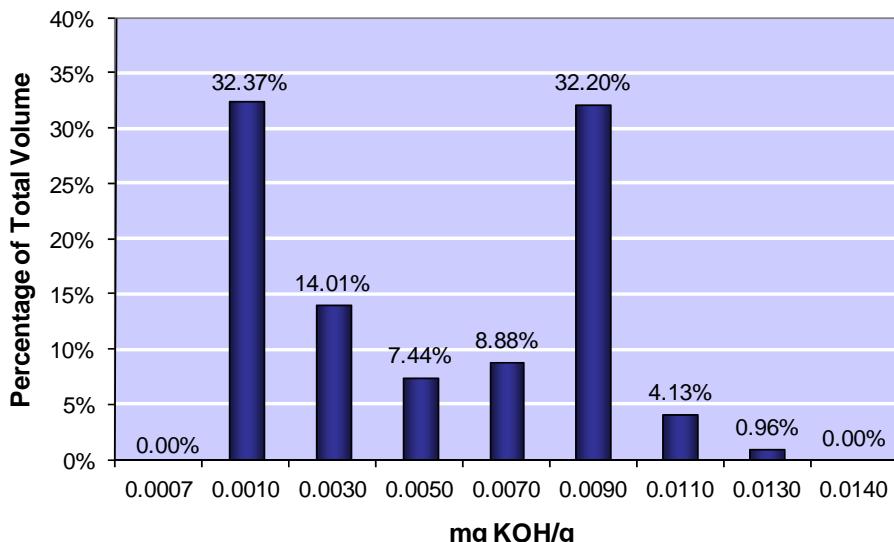


Figure 6-1: Total Acid Number (mg KOH/g), maximum 0.015

## Total Acid Number 8-Year Trend—Weighted Mean

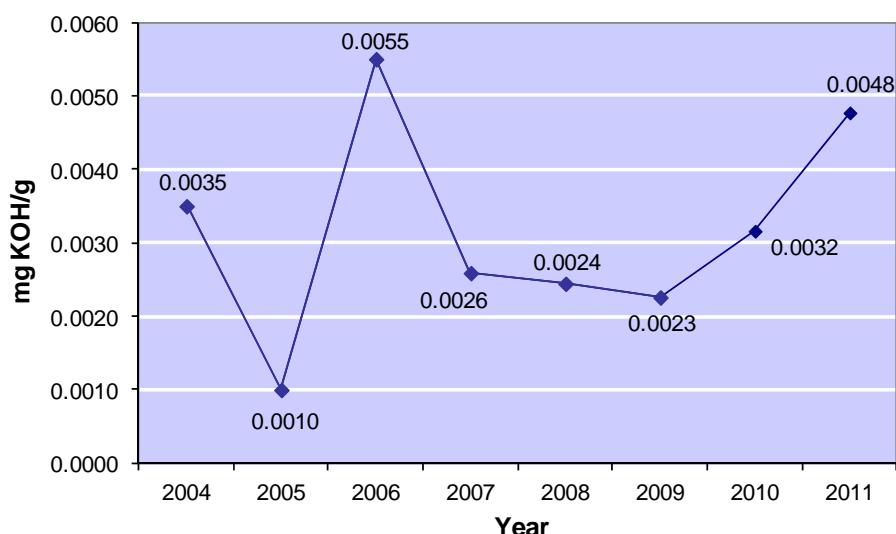


Figure 6-2: Total Acid Number (mg KOH/g), 8-Year Trend, maximum 0.015

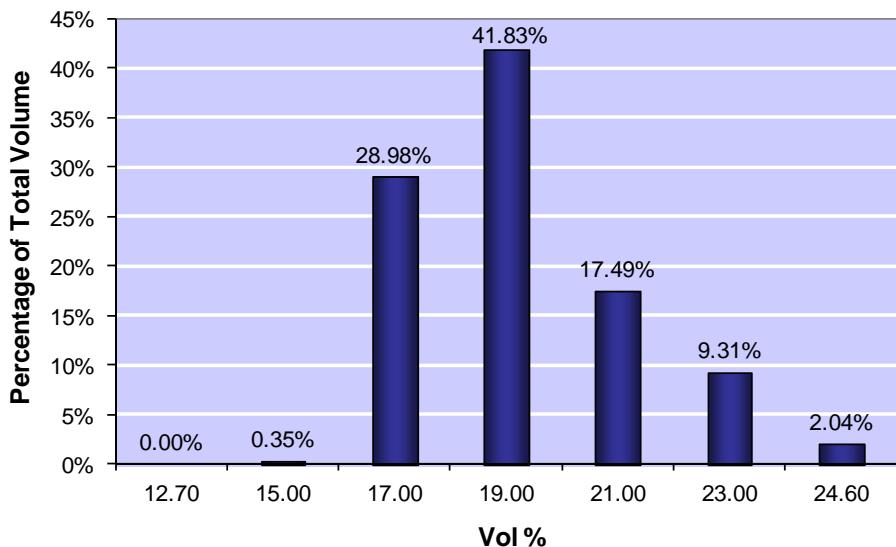
**Aromatics—2011**

Figure 6-3: Aromatics (vol %), maximum 25.0

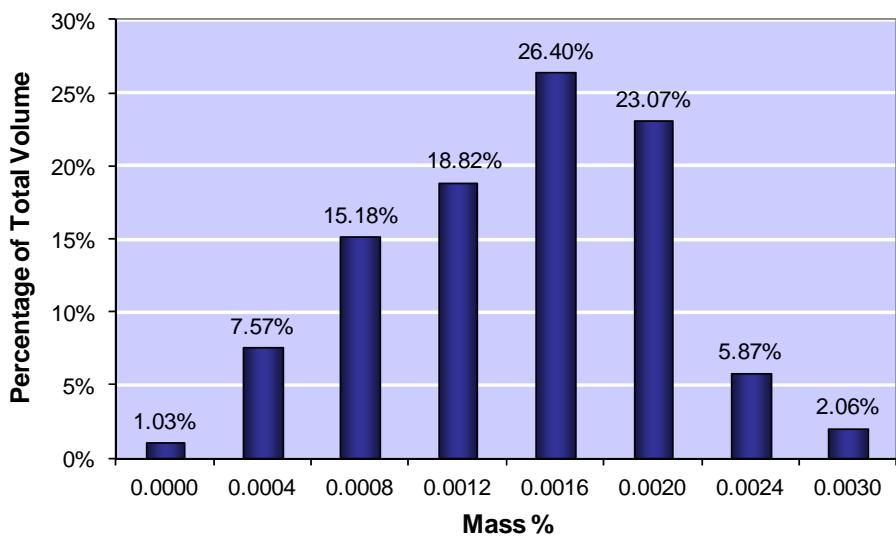
**Sulfur Mercaptan—2011**

Figure 6-4: Sulfur Mercaptan (mass %), maximum 0.003

## Sulfur, Total—2011

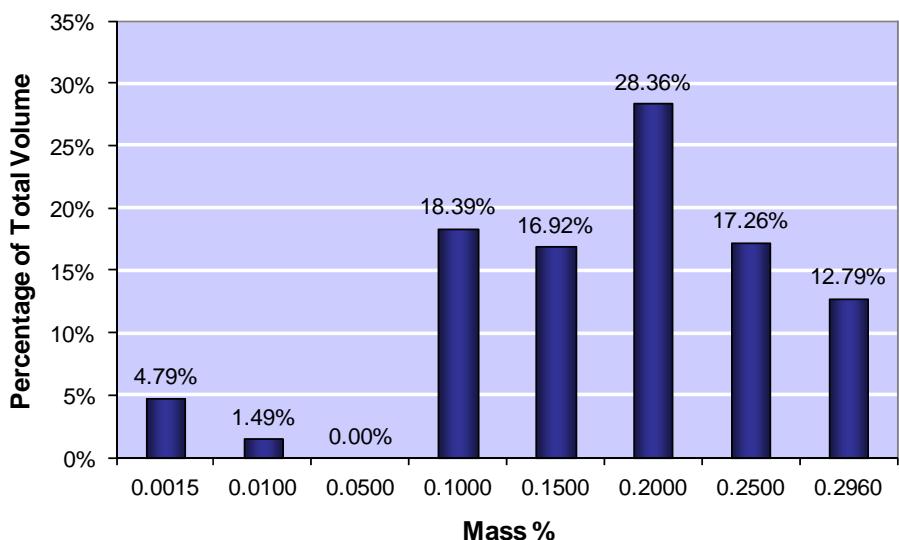


Figure 6-5: Sulfur, Total (mass %), maximum 0.30

## Sulfur, Total 8-Year Trend—Weighted Mean

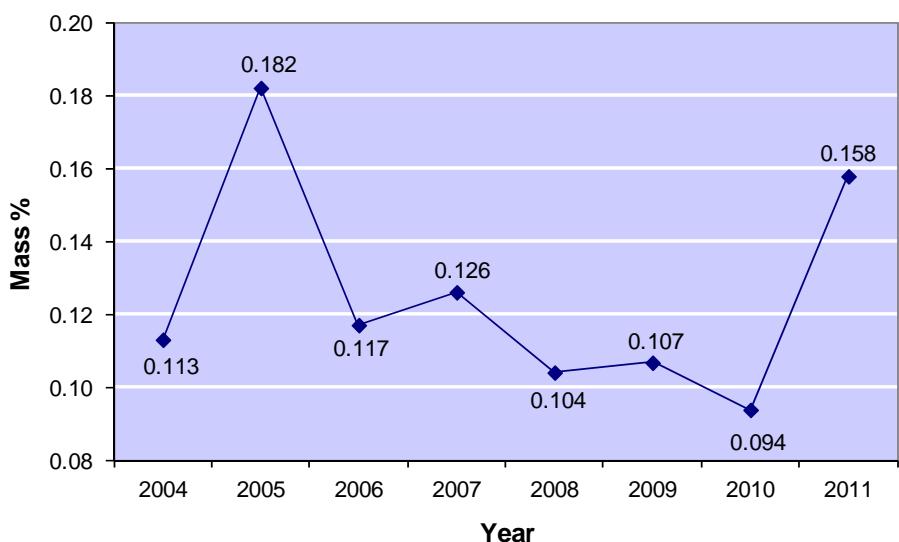


Figure 6-6: Sulfur, Total (mass %), 8-Year Trend, maximum 0.30

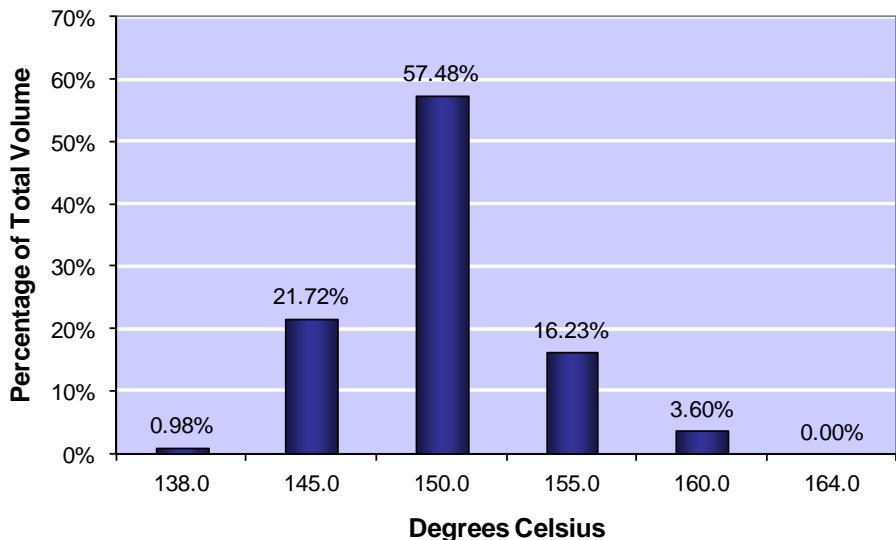
**Distillation IBP—2011**

Figure 6-7: Distillation Initial Boiling Point (IBP) (°C), Report

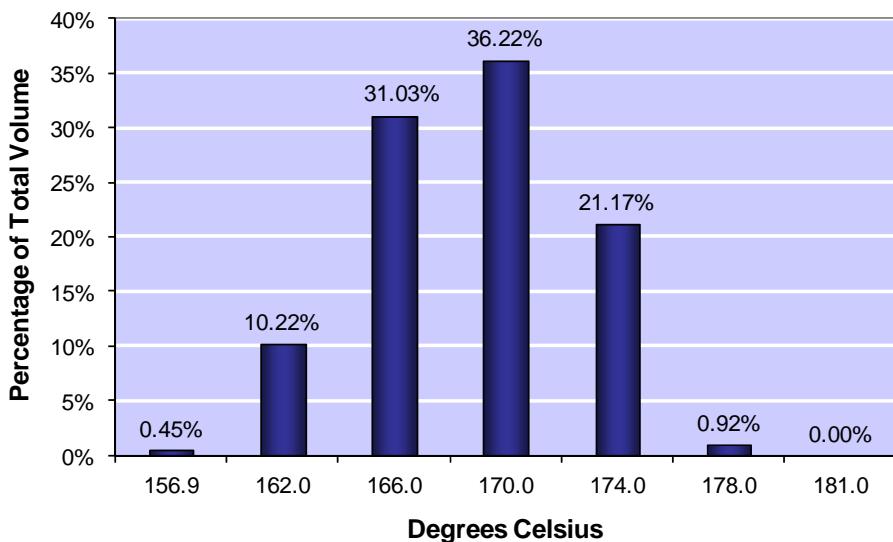
**Distillation 10% Recovered—2011**

Figure 6-8: Distillation 10% Recovered (°C), maximum 205.0

## Distillation 50% Recovered—2011

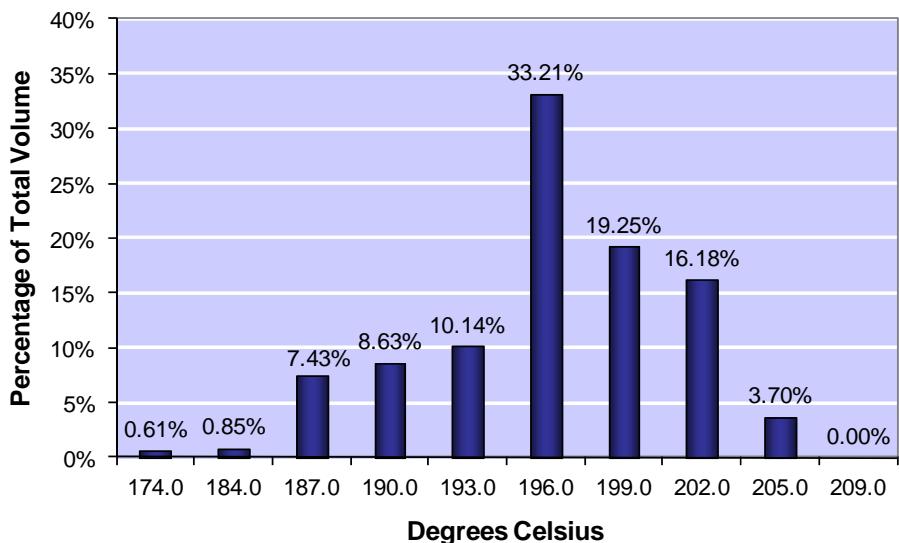


Figure 6-9: Distillation 50% Recovered (°C), Report

## Distillation 90% Recovered—2011

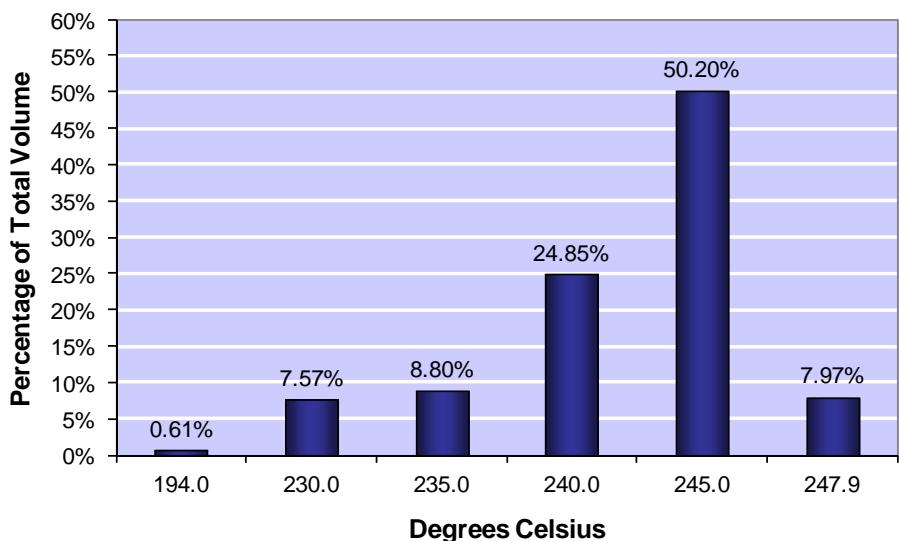


Figure 6-10: Distillation 90% Recovered (°C), Report

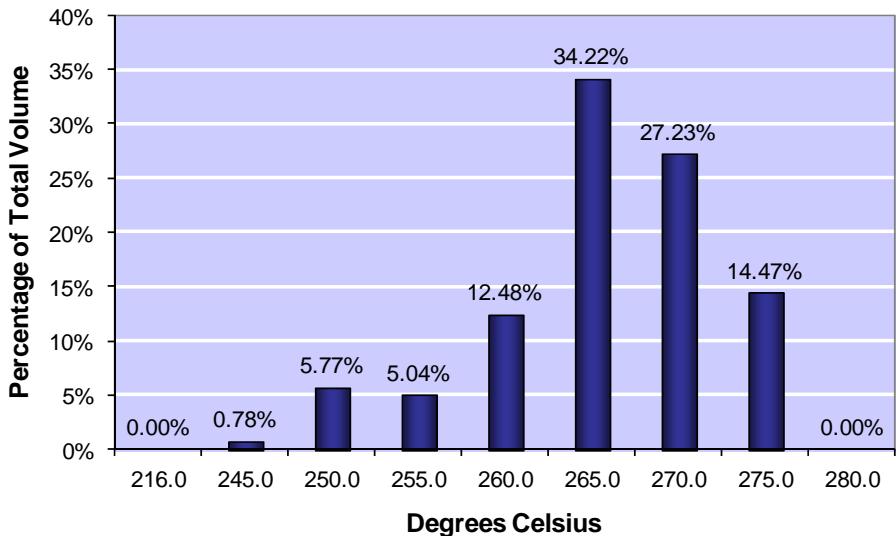
**Distillation FBP—2011**

Figure 6-11: Distillation Final Boiling Point (FBP) (°C), maximum 300.0

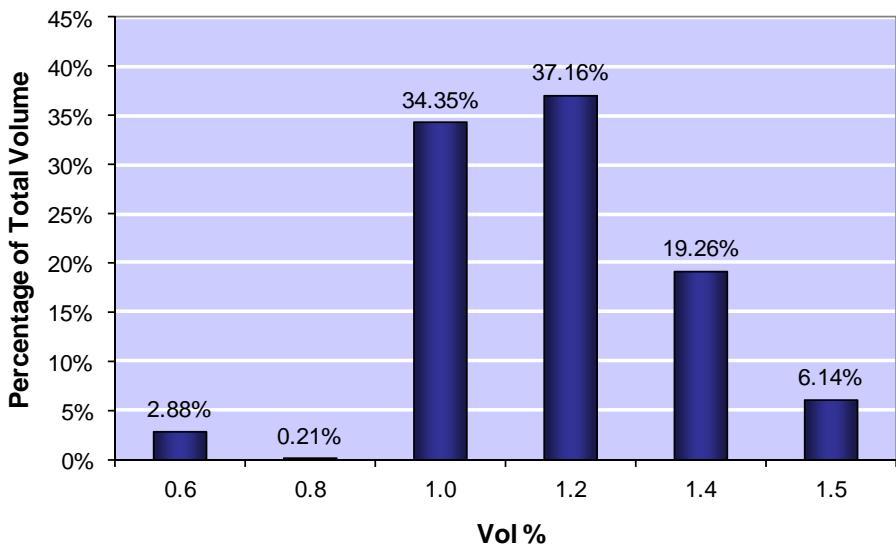
**Distillation Residue—2011**

Figure 6-12: Distillation Residue (vol %), maximum 1.5

## Distillation Loss—2011

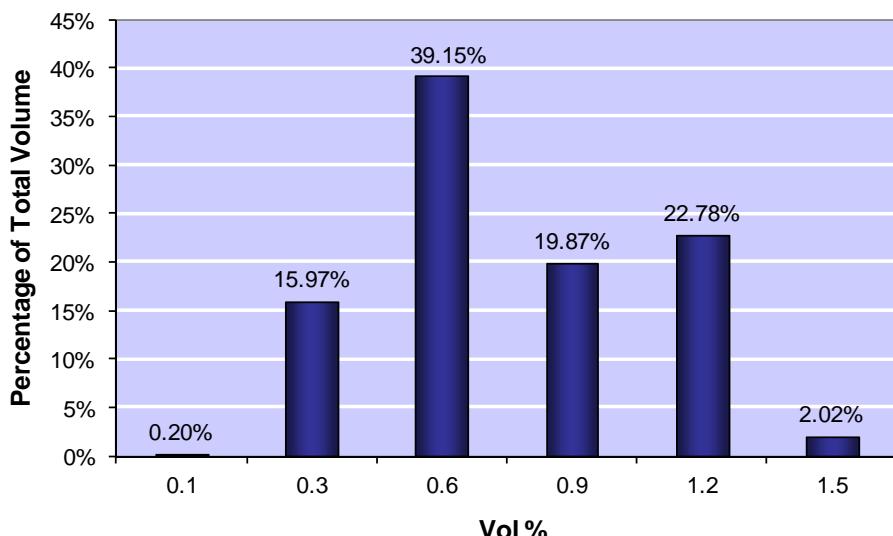


Figure 6-13: Distillation Loss (vol %), maximum 1.5

## Distillation Loss 8-Year Trend—Weighted Mean

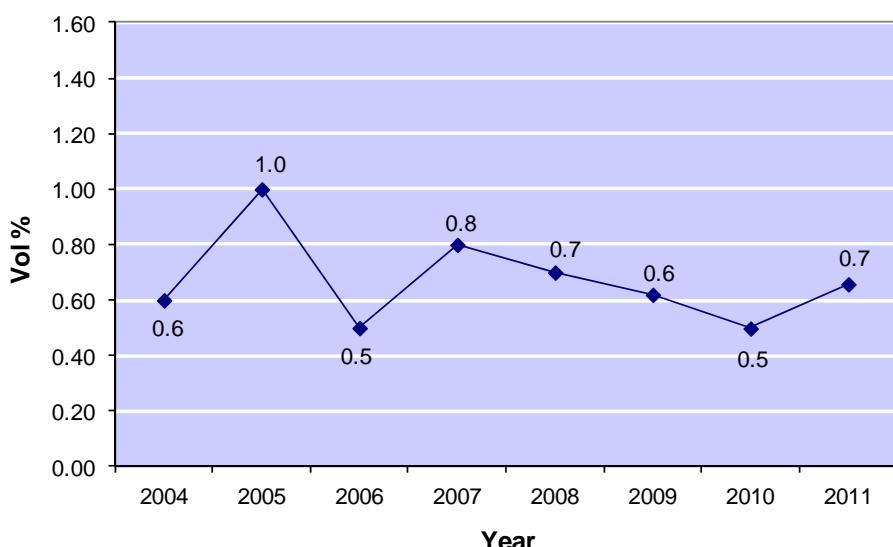


Figure 6-14: Distillation Loss (vol %), 8-Year Trend, maximum 1.5

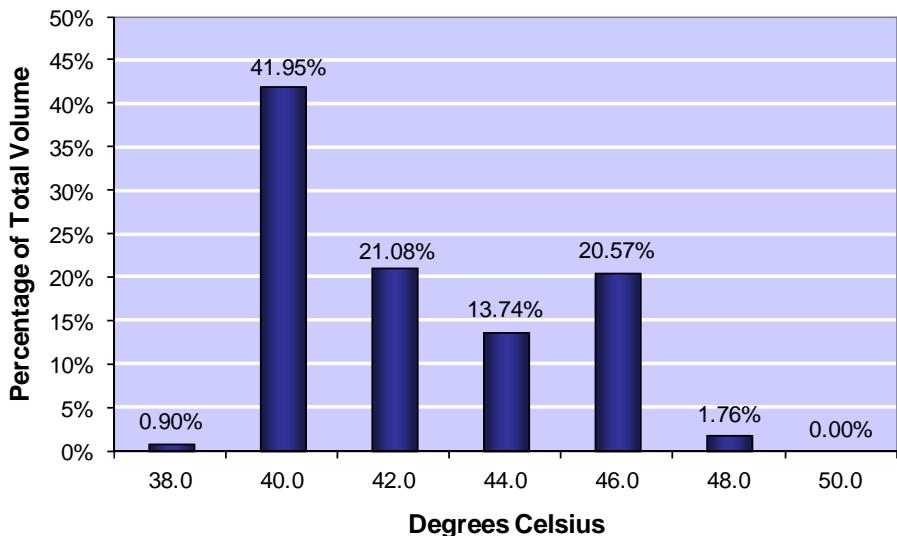
**Flash Point—2011**

Figure 6-15: Flash Point (°C), minimum 38.0

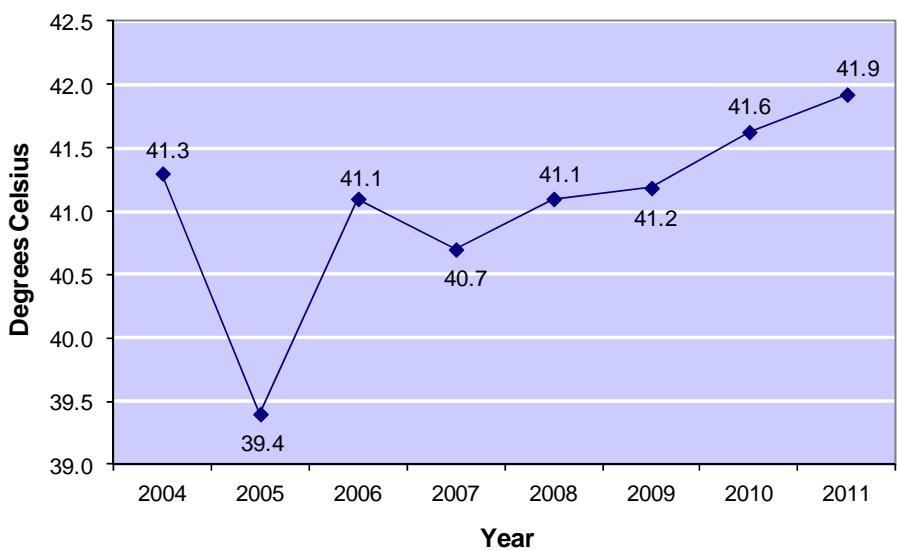
**Flash Point 8-Year Trend—Weighted Mean**

Figure 6-16: Flash Point (°C), 8-Year Trend, minimum 38.0

## Density—2011

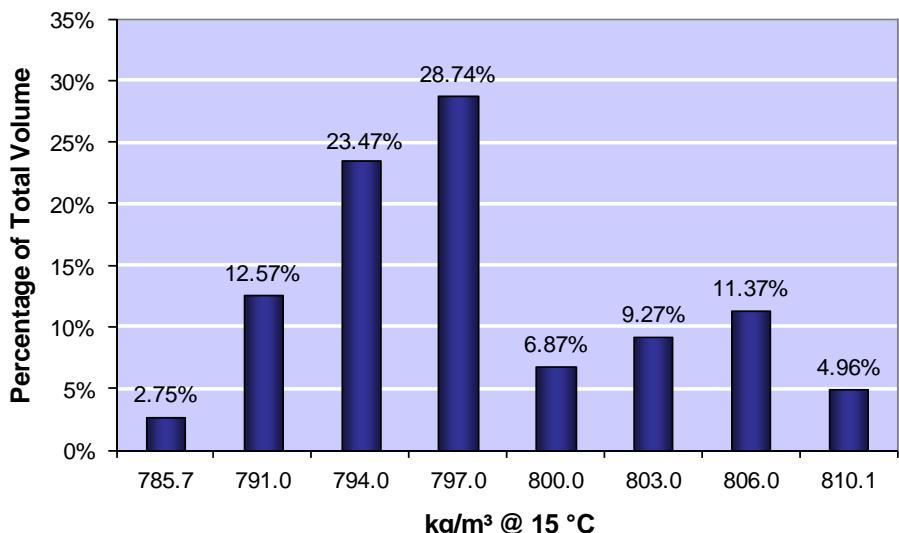


Figure 6-17: Density (kg/m<sup>3</sup> @ 15 °C), minimum 775, maximum 840

## Density 6-Year Trend—Weighted Mean

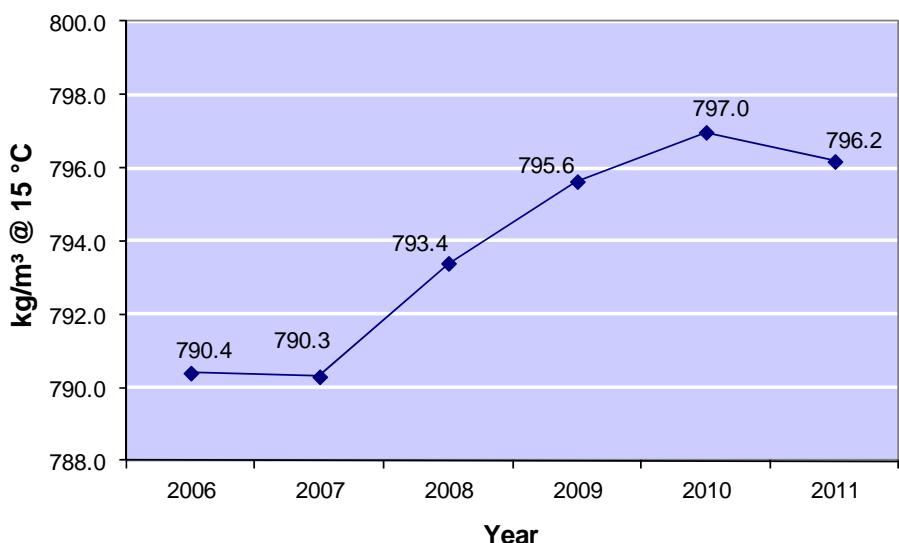


Figure 6-18: Density (kg/m<sup>3</sup> @ 15 °C), 6-Year Trend, minimum 775, maximum 840

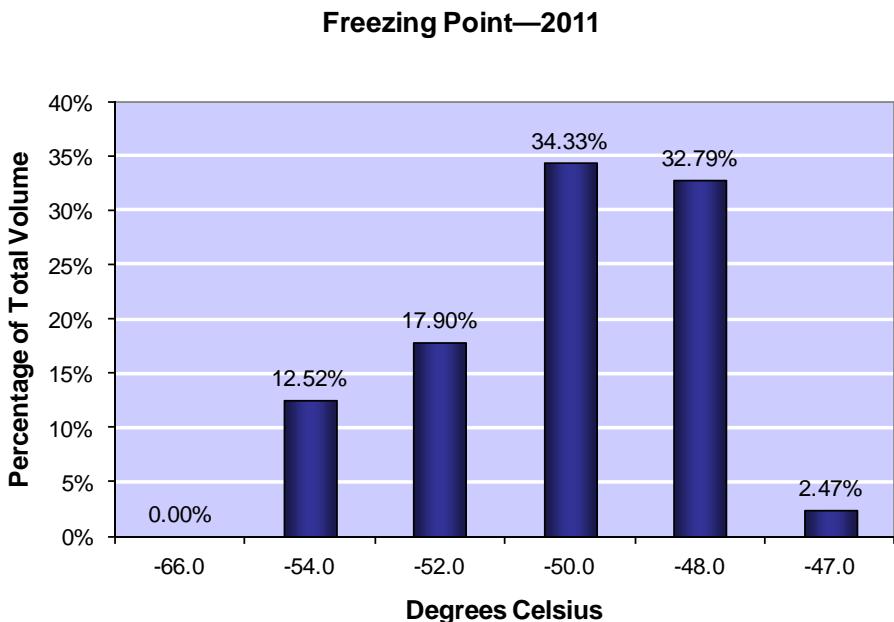


Figure 6-19: Freezing Point ( $^{\circ}\text{C}$ ), maximum  $-47$

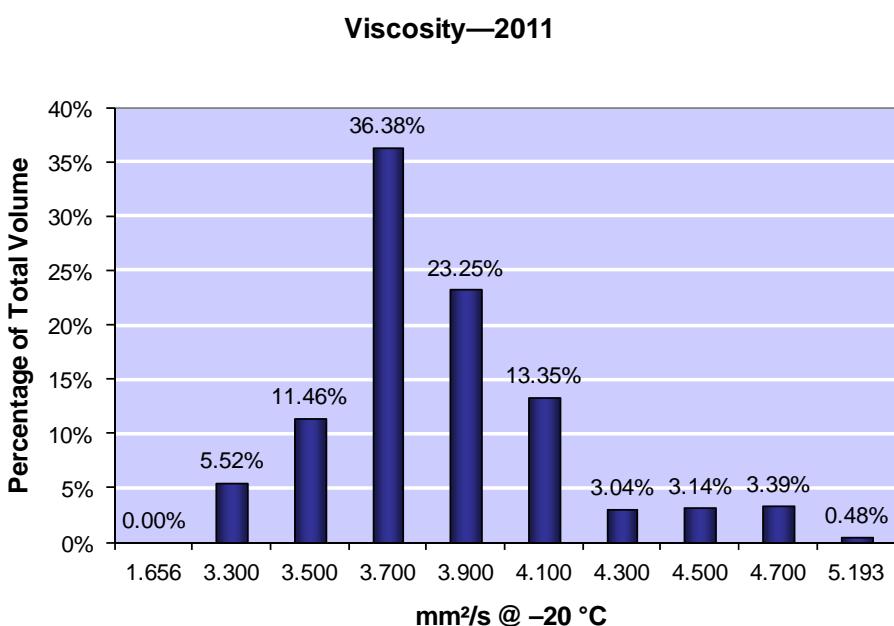


Figure 6-20: Viscosity ( $\text{mm}^2/\text{s} @ -20 ^{\circ}\text{C}$ ), maximum 8.0

## Net Heat of Combustion—2011

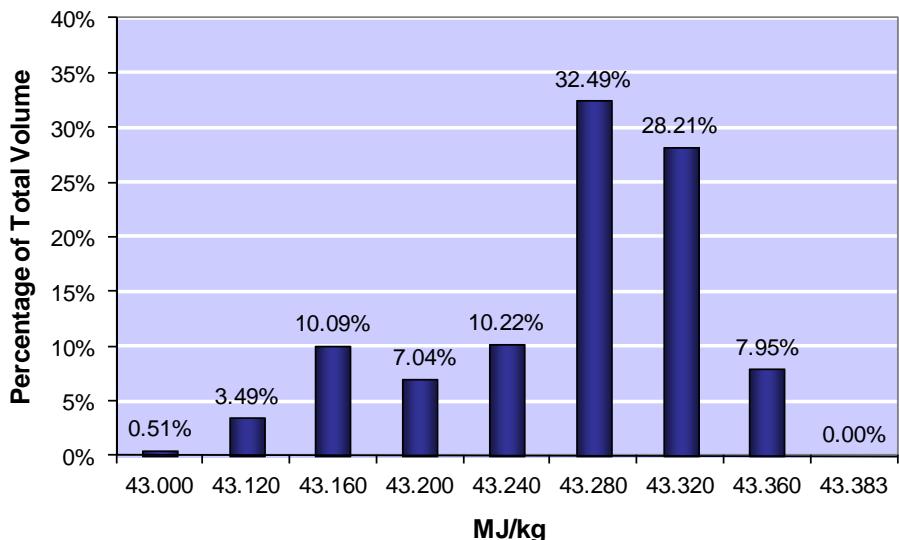


Figure 6-21: Net Heat of Combustion (MJ/kg), minimum 42.80

## Net Heat of Combustion 8-Year Trend—Weighted Mean

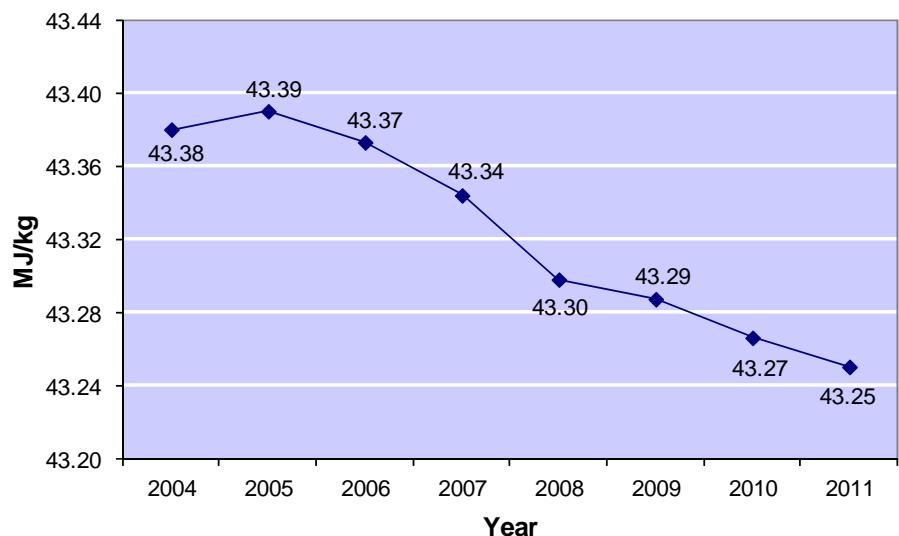


Figure 6-22: Net Heat of Combustion (MJ/kg), 8-Year Trend, minimum 42.80

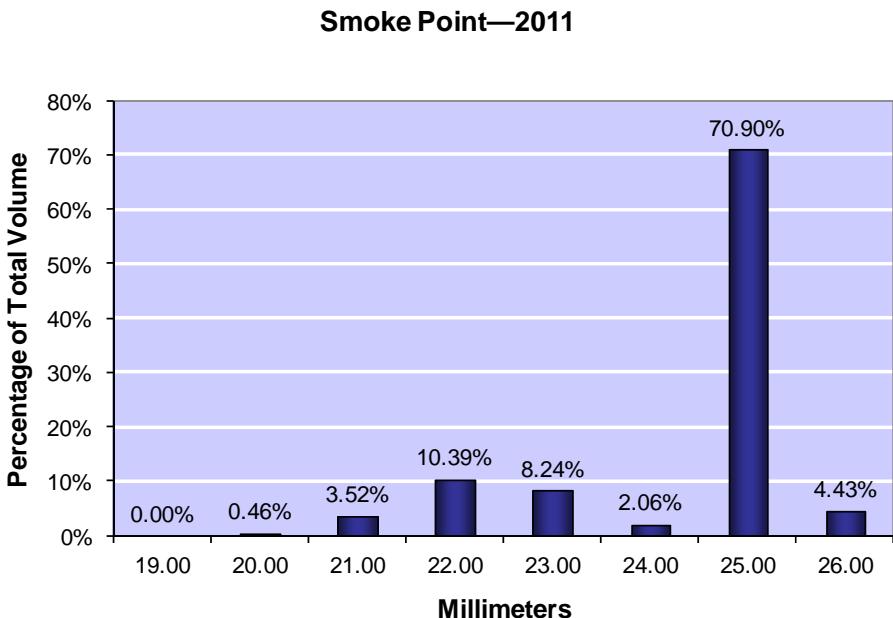


Figure 6-23: Smoke Point (mm), minimum 25.0

**NOTE:** When the smoke point result is below 25 mm, the product is acceptable so long as the naphthalene content is below 3.0 percent and the smoke point is above the minimum of 19 mm.

### Smoke Point 8-Year Trend—Weighted Mean

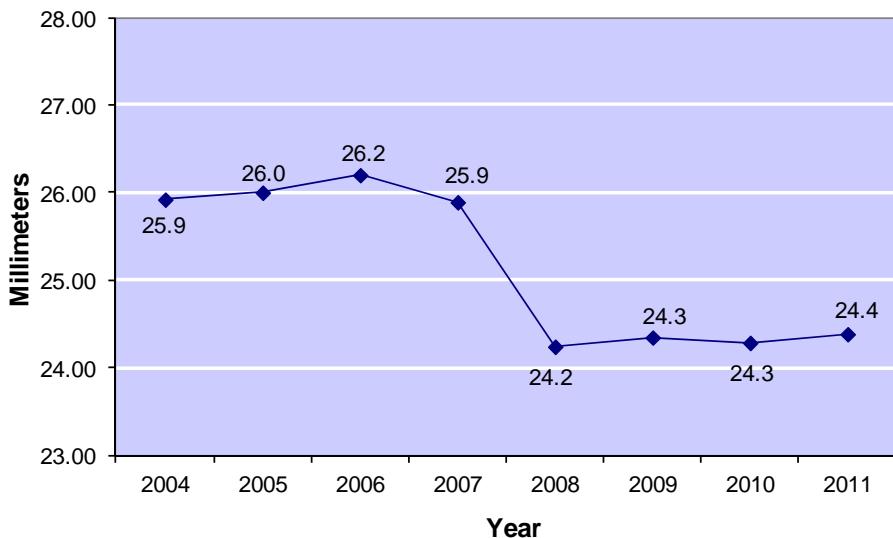


Figure 6-24: Smoke Point (mm), 8-Year Trend, minimum 25.0

## Naphthalene—2011

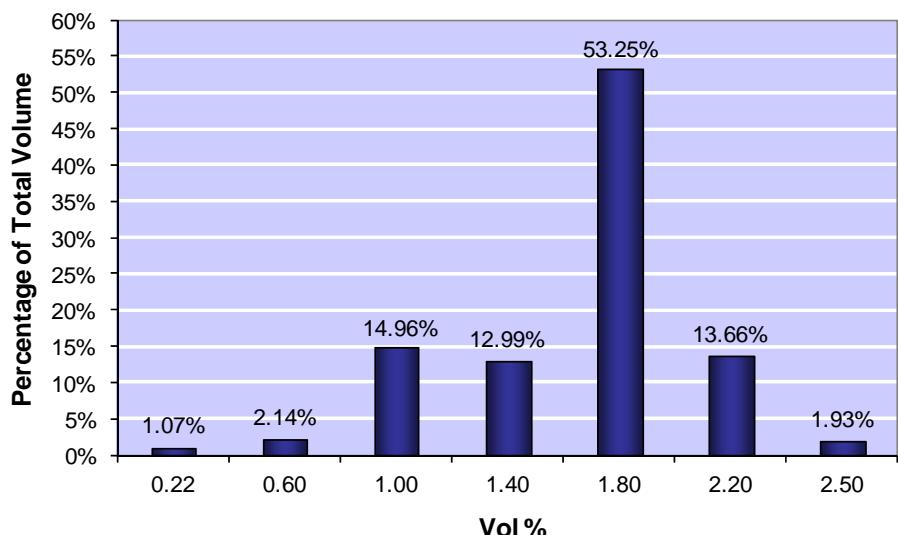


Figure 6-25: Naphthalene (vol %), maximum 3.0

## Thermal Stability (JFTOT @ 260 °C)—2011

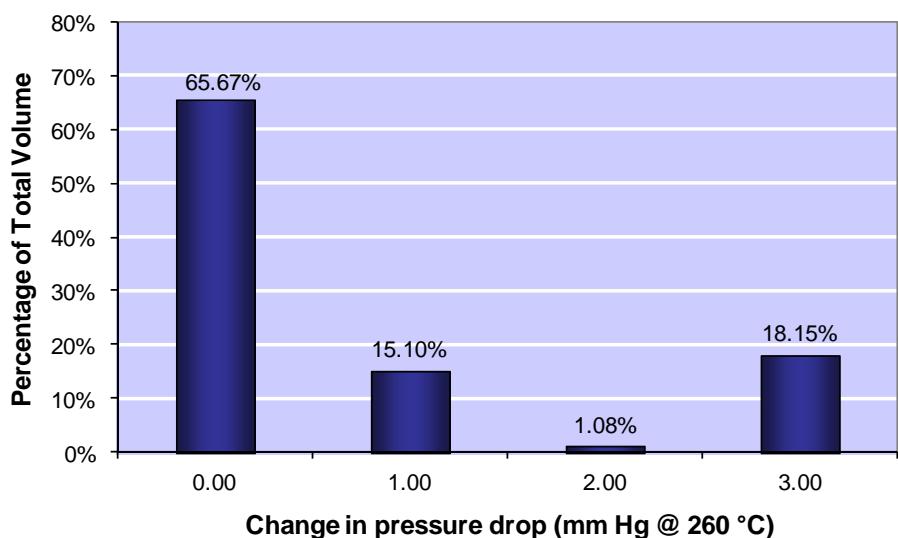


Figure 6-26: Thermal Stability, Change in Pressure Drop (mm Hg @ 260 °C), maximum 25

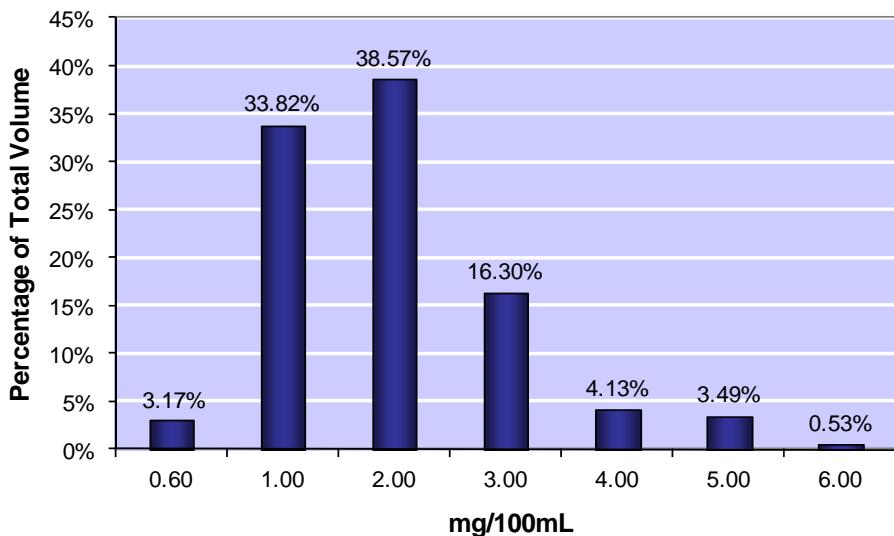
**Existent Gum—2011**

Figure 6-27: Existent Gum (mg/100 mL), maximum 7

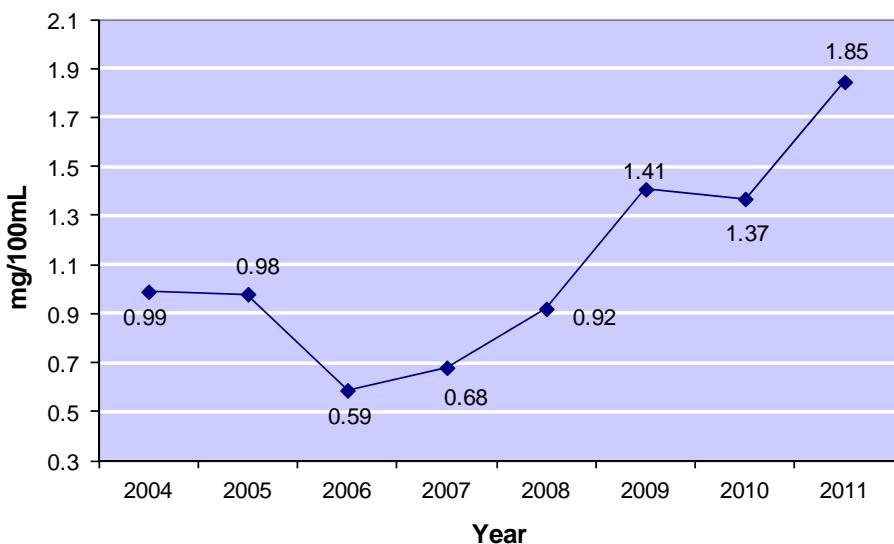
**Existent Gum 8-Year Trend—Weighted Mean**

Figure 6-28: Existent Gum (mg/100 mL), 8-Year Trend, maximum 7

## Water Separation Index—2011

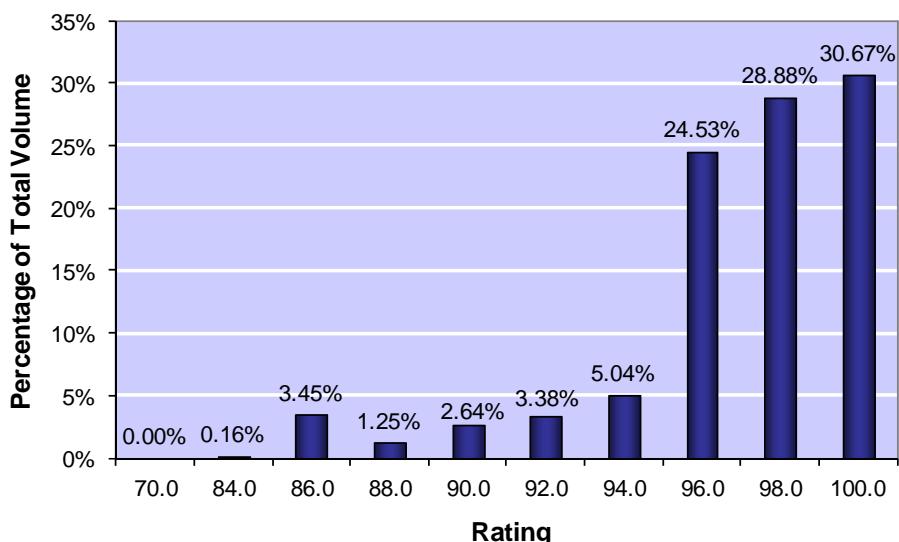


Figure 6-29: Water Separation Index (rating), minimum 70

**NOTE:** The minimum Water Separation Index rating with SDA is 70. The minimum Water Separation Index rating without SDA is 85.



# F76–2011 Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)			
Property	2011 Source Inputs		
	Region	Volume	Batches
<b>Acid Number:</b> (mg KOH/g)	All	541.87	103
<b>Sulfur Content:</b> (wt. %)	All	556.87	105
<b>Distillation:</b>			
10% Point (°C)	All	578.42	108
50% Point (°C)	All	578.42	108
90% Point (°C)	All	578.42	108
End Point (°C)	All	578.42	108
Residue + Loss (vol %)	All	578.42	108
<b>Flash Point:</b> (°C)	All	588.39	109
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)	All	526.23	95
<b>Viscosity:</b> (mm <sup>2</sup> /s @ 40 °C)	All	541.87	103
<b>Cetane Index:</b> (calculated)	All	527.19	97
<b>Hydrogen Content:</b> (wt. %)	All	541.87	103
<b>Cloud Point:</b> (°C)	All	554.86	105
<b>Pour Point:</b> (°C)	All	377.79	73
<b>Ash:</b> (wt. %)	All	535.41	102
<b>Particulate Contamination:</b> (mg/L)	All	566.91	106
<b>Carbon Residue on 10% Bottoms:</b>			
D-524 (wt. %)	All	324.12	72
D-189 & D-4530 (wt. %)	All	233.01	33
<b>Demulsification:</b> (minutes @ 25 °C)	All	372.50	74
<b>Color:</b>	All	588.39	109
<b>Storage Stability:</b>			
D-2274 (mg/100mL)	All	190.61	41
D-5304 (mg/100mL)	All	341.61	59
<b>Calcium:</b> (ppm)	All	537.39	102
<b>Lead:</b> (ppm)	All	390.65	71
<b>Sodium + Potassium:</b> (ppm)	All	537.39	102
<b>Vanadium:</b> (ppm)	All	537.39	102

Table 7-1: Data Summary, MIL-DTL-16884 Fuel, Naval Distillate (NATO F-76), 2011 Source Inputs

# F76–2011 Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Acid Number:</b> (mg KOH/g)		<b>0.30</b>	0.002	0.273	0.088	0.080
<b>Sulfur Content:</b> (wt. %)		<b>0.5</b>	0.0012	0.4920	0.277	0.293
<b>Distillation:</b>						
10% Point (°C)	<b>Report</b>		195.9	258.1	218.1	216.9
50% Point (°C)	<b>Report</b>		224.2	296.4	273.8	275.2
90% Point (°C)		<b>357</b>	275.2	351.5	332.0	335.3
End Point (°C)		<b>385</b>	305.5	378.4	358.7	362.3
Residue + Loss (vol %)		<b>3.0</b>	0.9	2.9	1.86	1.84
<b>Flash Point:</b> (°C)	<b>60</b>		61.0	93.0	69.84	68.93
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)		<b>876</b>	831.9	868.1	844.5	842.6
<b>Viscosity:</b> (mm <sup>2</sup> /s @ 40 °C)	<b>1.7</b>	<b>4.3</b>	1.816	3.930	2.945	2.955
<b>Cetane Index:</b> (calculated)	<b>43</b>		38.20	58.00	50.57	51.27
<b>Hydrogen Content:</b> (wt. %)	<b>12.5</b>		12.70	14.60	13.46	13.53
<b>Cloud Point:</b> (°C)		<b>-1</b>	-50.0	-1.0	-9.6	-7.1
<b>Pour Point:</b> (°C)		<b>-6</b>	-57.0	-6.0	-17.0	-13.9
<b>Ash:</b> (wt. %)		<b>0.005</b>	0.0000	0.0050	0.0013	0.0014
<b>Particulate Contamination:</b> (mg/L)		<b>10</b>	0.00	7.90	1.84	1.79
<b>Carbon Residue on 10% Bottoms:</b>						
D-524 (wt. %)		<b>0.20</b>	0.020	0.190	0.088	0.084
D-189 & D-4530 (wt. %)		<b>0.14</b>	0.004	0.100	0.030	0.030
<b>Demulsification:</b> (minutes @ 25 °C)		<b>10</b>	0.00	10.00	2.68	2.77
<b>Color:</b>		<b>3</b>	0.50	3.00	0.90	0.90
<b>Storage Stability:</b>						
D-2274 (mg/100mL)		<b>1.5</b>	0.00	1.40	0.69	0.74
D-5304 (mg/100mL)		<b>3.0</b>	0.00	3.00	1.07	1.07
<b>Calcium:</b> (ppm)		<b>1.0</b>	0.00	0.97	0.19	0.22
<b>Lead:</b> (ppm)		<b>0.5</b>	0.00	0.50	0.11	0.11
<b>Sodium + Potassium:</b> (ppm)		<b>1.0</b>	0.00	1.00	0.29	0.30
<b>Vanadium:</b> (ppm)		<b>0.5</b>	0.00	0.50	0.12	0.12

Table 7-2: Data Summary, MIL-DTL-16884 Fuel, Naval Distillate (NATO F-76), 2011 Test Results

# F76-2011 Regional Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)						
Property	Total Volume		100.16			
	Batch Analysis		21			
	Specification Limits		Region 3			
	Min	Max	Min	Max	Mean	Wt Mean
Acid Number: (mg KOH/g)		0.30	0.090	0.260	0.194	0.195
Sulfur Content: (wt. %)		0.5	0.087	0.439	0.177	0.170
Distillation:						
10% Point (°C)		Report	199.2	232.7	215.7	216.1
50% Point (°C)		Report	252.9	285.3	263.3	263.1
90% Point (°C)		357	320.8	337.3	327.7	327.0
End Point (°C)		385	344.7	362.4	354.4	353.8
Residue + Loss (vol %)		3.0	0.9	2.5	1.60	1.58
Flash Point: (°C)	60		61.0	73.0	66.52	66.58
Density: (kg/m <sup>3</sup> @ 15 °C)		876	835.4	866.0	851.0	849.5
Viscosity: (mm <sup>2</sup> /s @ 40 °C)	1.7	4.3	2.090	3.200	2.619	2.588
Cetane Index: (calculated)	43		43.00	50.20	45.97	46.43
Hydrogen Content: (wt. %)	12.5		12.70	13.96	13.29	13.33
Cloud Point: (°C)		-1	-16.0	-8.0	-10.2	-10.2
Pour Point: (°C)		-6	-21.0	-12.0	-16.4	-16.7
Ash: (wt. %)		0.005	0.0001	0.0050	0.0029	0.0032
Particulate Contamination: (mg/L)		10	0.20	7.90	2.87	2.68
Carbon Residue on 10% Bottoms:						
D-524 (wt. %)		0.20	0.0453	0.180	0.099	0.095
D-189 & D-4530 (wt. %)		0.14	NR	NR	NR	NR
Demulsification: (minutes @ 25 °C)		10	0.00	5.00	1.28	1.22
Color:		3	0.50	2.50	1.60	1.55
Storage Stability:						
D-2274 (mg/100mL)		1.5	1.10	1.40	1.30	1.31
D-5304 (mg/100mL)		3.0	0.00	3.00	1.20	1.25
Calcium: (ppm)		1.0	0.10	0.97	0.17	0.21
Lead: (ppm)		0.5	0.10	0.10	0.10	0.10
Sodium + Potassium: (ppm)		1.0	0.10	0.90	0.33	0.32
Vanadium: (ppm)		0.5	0.10	0.20	0.11	0.11

Table 7-3: Region 3 Summary

# F76–2011 Regional Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)						
Property	Total Volume		83.86			
	Batch Analysis		23			
	Specification Limits		Region 5			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Acid Number:</b> (mg KOH/g)		<b>0.30</b>	0.002	0.133	0.055	0.059
<b>Sulfur Content:</b> (wt. %)		<b>0.5</b>	0.0012	0.474	0.138	0.174
<b>Distillation:</b>						
10% Point (°C)		<b>Report</b>	196.0	240.9	217.6	218.0
50% Point (°C)		<b>Report</b>	224.2	296.4	267.7	272.3
90% Point (°C)		<b>357</b>	275.2	334.5	314.5	318.9
End Point (°C)		<b>385</b>	305.5	355.3	340.3	343.7
Residue + Loss (vol %)		<b>3.0</b>	1.2	2.7	1.93	1.93
<b>Flash Point:</b> (°C)	<b>60</b>		62.0	87.0	72.61	72.36
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)		<b>876</b>	842.1	868.1	857.0	856.9
<b>Viscosity:</b> (mm <sup>2</sup> /s @ 40 °C)	<b>1.7</b>	<b>4.3</b>	1.816	3.930	2.877	2.966
<b>Cetane Index:</b> (calculated)	<b>43</b>		38.20	53.30	48.27	49.39
<b>Hydrogen Content:</b> (wt. %)	<b>12.5</b>		12.80	13.60	13.34	13.37
<b>Cloud Point:</b> (°C)		<b>-1</b>	-50.0	-7.0	-24.3	-19.7
<b>Pour Point:</b> (°C)		<b>-6</b>	-57.0	-12.0	-41.5	-37.9
<b>Ash:</b> (wt. %)		<b>0.005</b>	0.0000	0.0010	0.0006	0.0007
<b>Particulate Contamination:</b> (mg/L)		<b>10</b>	0.20	6.26	2.10	2.16
<b>Carbon Residue on 10% Bottoms:</b>						
D-524 (wt. %)		<b>0.20</b>	0.020	0.190	0.093	0.082
D-189 & D-4530 (wt. %)		<b>0.14</b>	NR	NR	NR	NR
<b>Demulsification:</b> (minutes @ 25 °C)		<b>10</b>	0.00	5.00	3.21	3.41
<b>Color:</b>		<b>3</b>	0.50	1.00	0.52	0.53
<b>Storage Stability:</b>						
D-2274 (mg/100mL)		<b>1.5</b>	0.20	0.90	0.61	0.60
D-5304 (mg/100mL)		<b>3.0</b>	0.60	2.20	1.17	1.19
<b>Calcium:</b> (ppm)		<b>1.0</b>	0.10	0.50	0.17	0.19
<b>Lead:</b> (ppm)		<b>0.5</b>	0.10	0.50	0.18	0.20
<b>Sodium + Potassium:</b> (ppm)		<b>1.0</b>	0.10	1.00	0.35	0.32
<b>Vanadium:</b> (ppm)		<b>0.5</b>	0.10	0.50	0.17	0.19

Table 7-4: Region 5 Summary

# F76-2011 Regional Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)						
Property	Total Volume		65.14			
	Batch Analysis		11			
	Specification Limits		Region 6			
	Min	Max	Min	Max	Mean	Wt Mean
Acid Number: (mg KOH/g)		0.30	0.010	0.020	0.019	0.019
Sulfur Content: (wt. %)		0.5	0.100	0.400	0.318	0.310
Distillation:						
10% Point (°C)		Report	199.4	226.8	209.1	207.2
50% Point (°C)		Report	275.4	294.0	285.0	283.6
90% Point (°C)		357	338.0	351.0	344.2	343.7
End Point (°C)		385	362.0	370.0	366.1	366.3
Residue + Loss (vol %)		3.0	1.2	2.3	1.68	1.67
Flash Point: (°C)	60		62.0	67.0	64.91	64.80
Density: (kg/m <sup>3</sup> @ 15 °C)		876	833.3	839.5	835.4	836.2
Viscosity: (mm <sup>2</sup> /s @ 40 °C)	1.7	4.3	2.700	3.500	3.073	3.017
Cetane Index: (calculated)	43		53.00	58.00	55.55	55.10
Hydrogen Content: (wt. %)	12.5		13.30	13.80	13.63	13.58
Cloud Point: (°C)		-1	-6.0	-1.0	-3.1	-3.2
Pour Point: (°C)		-6	-12.0	-6.0	-8.7	-8.5
Ash: (wt. %)		0.005	0.0000	0.0000	0.0000	0.0000
Particulate Contamination: (mg/L)		10	1.00	3.00	1.27	1.20
Carbon Residue on 10% Bottoms:						
D-524 (wt. %)		0.20	0.040	0.070	0.056	0.059
D-189 & D-4530 (wt. %)		0.14	NR	NR	NR	NR
Demulsification: (minutes @ 25 °C)		10	1.00	2.00	1.09	1.07
Color:		3	0.50	1.00	0.59	0.63
Storage Stability:						
D-2274 (mg/100mL)		1.5	NR	NR	NR	NR
D-5304 (mg/100mL)		3.0	0.40	2.00	1.16	1.19
Calcium: (ppm)		1.0	0.10	0.70	0.25	0.21
Lead: (ppm)		0.5	0.10	0.10	0.10	0.10
Sodium + Potassium: (ppm)		1.0	0.10	0.20	0.11	0.11
Vanadium: (ppm)		0.5	0.20	0.40	0.23	0.22

Table 7-5: Region 6 Summary

# F76–2011 Regional Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)						
Property	Total Volume		111.10			
	Batch Analysis		18			
	Specification Limits		Region 7			
	Min	Max	Min	Max	Mean	Wt Mean
<b>Acid Number:</b> (mg KOH/g)		<b>0.30</b>	0.010	0.130	0.059	0.060
<b>Sulfur Content:</b> (wt. %)		<b>0.5</b>	0.190	0.490	0.416	0.418
<b>Distillation:</b>						
10% Point (°C)		<b>Report</b>	195.9	227.0	212.0	212.9
50% Point (°C)		<b>Report</b>	264.9	285.0	275.8	277.1
90% Point (°C)		<b>357</b>	335.3	349.0	342.1	342.6
End Point (°C)		<b>385</b>	366.8	378.4	372.2	372.9
Residue + Loss (vol %)		<b>3.0</b>	1.6	2.9	2.03	2.02
<b>Flash Point:</b> (°C)	<b>60</b>		61.0	75.0	65.61	65.44
<b>Density:</b> (kg/m <sup>3</sup> @ 15 °C)		<b>876</b>	833.7	852.5	842.6	843.5
<b>Viscosity:</b> (mm <sup>2</sup> /s @ 40 °C)	<b>1.7</b>	<b>4.3</b>	2.586	3.330	2.938	2.981
<b>Cetane Index:</b> (calculated)	<b>43</b>		49.70	54.40	51.39	51.32
<b>Hydrogen Content:</b> (wt. %)	<b>12.5</b>		13.20	14.30	13.85	13.81
<b>Cloud Point:</b> (°C)		<b>-1</b>	-6.0	-1.0	-3.1	-2.9
<b>Pour Point:</b> (°C)		<b>-6</b>	-18.0	-6.0	-10.0	-10.6
<b>Ash:</b> (wt. %)		<b>0.005</b>	0.0010	0.0030	0.0019	0.0020
<b>Particulate Contamination:</b> (mg/L)		<b>10</b>	0.10	5.00	2.29	2.41
<b>Carbon Residue on 10% Bottoms:</b>						
D-524 (wt. %)		<b>0.200</b>	NR	NR	NR	NR
D-189 & D-4530 (wt. %)		<b>0.140</b>	0.008	0.100	0.040	0.043
<b>Demulsification:</b> (minutes @ 25 °C)		<b>10</b>	1.00	10.00	3.88	4.66
<b>Color:</b>		<b>3</b>	0.50	2.00	1.19	1.13
<b>Storage Stability:</b>						
D-2274 (mg/100mL)		<b>1.5</b>	0.70	1.20	0.89	0.87
D-5304 (mg/100mL)		<b>3.0</b>	0.00	1.20	0.67	0.76
<b>Calcium:</b> (ppm)		<b>1.0</b>	0.08	0.50	0.19	0.16
<b>Lead:</b> (ppm)		<b>0.5</b>	0.05	0.20	0.11	0.11
<b>Sodium + Potassium:</b> (ppm)		<b>1.0</b>	0.10	1.00	0.31	0.32
<b>Vanadium:</b> (ppm)		<b>0.5</b>	0.01	0.30	0.12	0.11

Table 7-6: Region 7 Summary

# F76-2011 Regional Data Summary

MIL-DTL-16884 Fuel, Naval Distillate (NATO Code F-76)						
Property	Total Volume		238.20			
	Batch Analysis		37			
	Specification Limits		Region 8			
	Min	Max	Min	Max	Mean	Wt Mean
Acid Number: (mg KOH/g)		0.30	0.020	0.273	0.080	0.060
Sulfur Content: (wt. %)		0.5	0.160	0.492	0.353	0.334
Distillation:						
10% Point (°C)		Report	198.0	258.1	225.7	221.7
50% Point (°C)		Report	261.2	294.9	279.6	278.5
90% Point (°C)		357	318.9	351.5	337.2	339.1
End Point (°C)		385	345.3	376.9	364.1	366.7
Residue + Loss (vol %)		3.0	1.2	2.6	1.94	1.88
Flash Point: (°C)	60		61.0	93.0	73.64	71.59
Density: (kg/m <sup>3</sup> @ 15 °C)	876		831.9	853.6	840.8	839.4
Viscosity: (mm <sup>2</sup> /s @ 40 °C)	1.7	4.3	2.474	3.890	3.160	3.105
Cetane Index: (calculated)	43		48.70	57.10	52.74	53.14
Hydrogen Content: (wt. %)	12.5		12.70	14.60	13.41	13.55
Cloud Point: (°C)		-1	-11.0	-1.0	-4.6	-3.7
Pour Point: (°C)		-6	-15.0	-6.0	-10.2	-9.6
Ash: (wt. %)	0.005		0.0000	0.0010	0.0010	0.0010
Particulate Contamination: (mg/L)		10	0.00	3.20	1.05	1.14
Carbon Residue on 10% Bottoms:						
D-524 (wt. %)		0.200	0.040	0.140	0.089	0.092
D-189 & D-4530 (wt. %)		0.140	0.004	0.030	0.021	0.020
Demulsification: (minutes @ 25 °C)		10	2.00	5.00	3.78	3.78
Color:		3	0.50	3.00	0.69	0.71
Storage Stability:						
D-2274 (mg/100mL)		1.5	0.00	1.30	0.56	0.62
D-5304 (mg/100mL)		3.0	0.62	1.10	0.92	0.93
Calcium: (ppm)		1.0	0.00	0.90	0.18	0.27
Lead: (ppm)		0.5	0.00	0.20	0.06	0.07
Sodium + Potassium: (ppm)		1.0	0.00	0.80	0.28	0.33
Vanadium: (ppm)		0.5	0.00	0.32	0.05	0.07

Table 7-7: Region 8 Summary

# F76—Assessment Summary

## **Overview:**

In 2011, 110 reported analyses, representing 598.46 million U.S. gallons of F76, were processed by Regions 3, 5, 6, 7, and 8. This represents a decrease from the 118 reported F76 analyses in 2010, but an increase in volume from the 499.34 million U.S. gallons queried from the PQIS in 2010.

## **Significant Trending:**

**Acid Number.** The weighted mean decreased 0.0185 mg KOH/g from 2010 to 2011.

**Sulfur Content.** The weighted mean increased 0.08 wt. % from 2010 to 2011 after having decreased 0.37 wt. % from 2007 to 2010.

**Distillation End Point.** The weighted mean increased 4.9 °C from 2010 to 2011 after having decreased 10.1 °C from 2006 to 2010.

**Flash Point.** Although there have been slight increases in various years, the weighted mean decreased 9.1 °C from 2002 to 2011.

**Particulate Matter.** The weighted mean decreased 0.72 mg/L from 2009 to 2011.

## **F76 Observations:**

All batches met specification requirements for 2011.

Five **Cetane Index** values fell below the minimum specification limit of 43. In each case, the supplier also performed the Cetane Number test in addition to the Cetane Index test. All Cetane Number values passed, so these Cetane Index values are acceptable.



# F76 Data

## Acid Number—2011

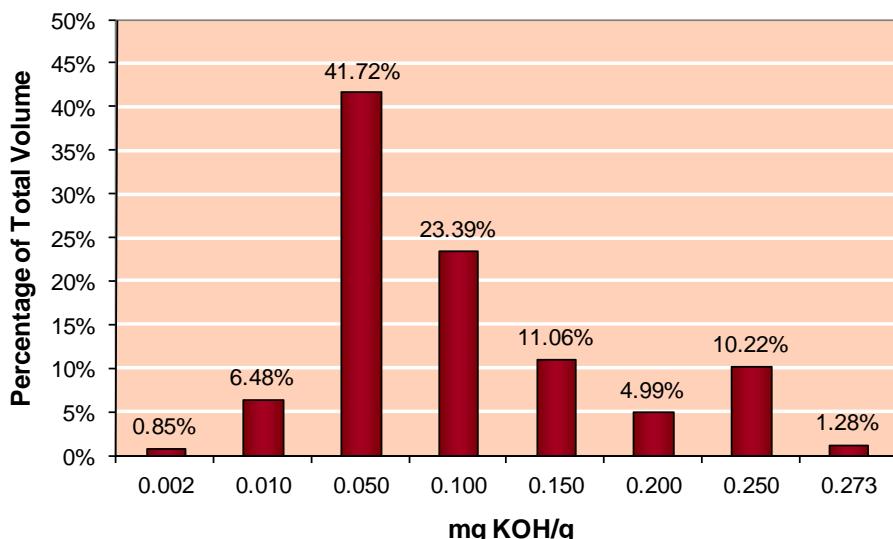


Figure 7-1: Acid Number (mg KOH/g), maximum 0.30

## Acid Number 11-Year Trend—Weighted Mean

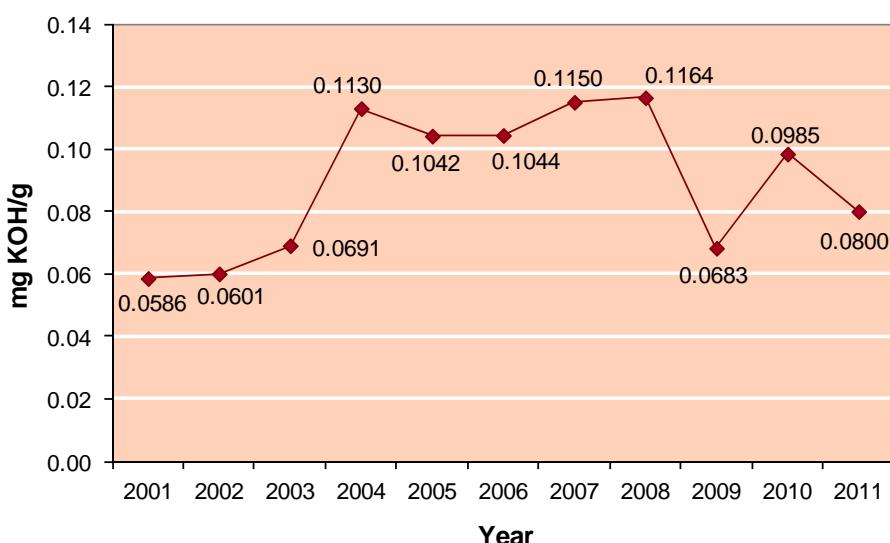


Figure 7-2: Acid Number (mg KOH/g), 11-Year Trend, maximum 0.30

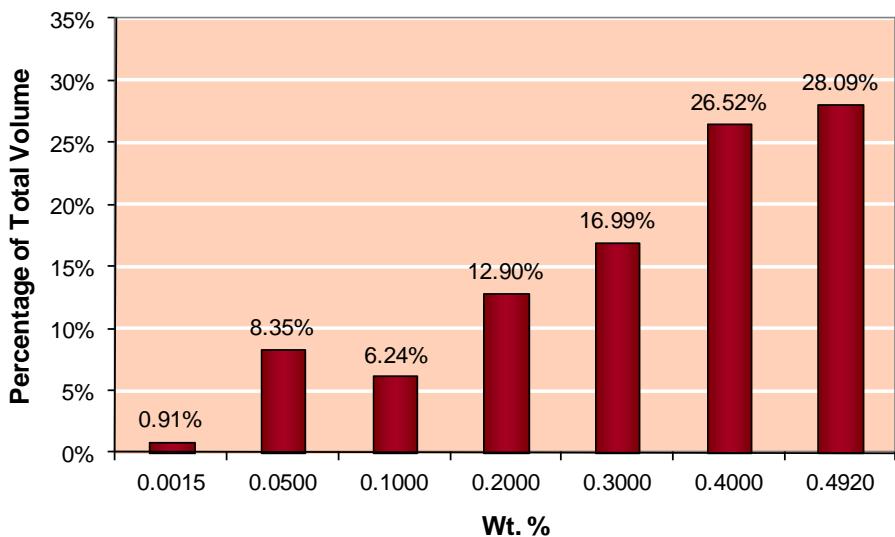
**Sulfur Content—2011**

Figure 7-3: Sulfur Content (wt. %), maximum 0.5

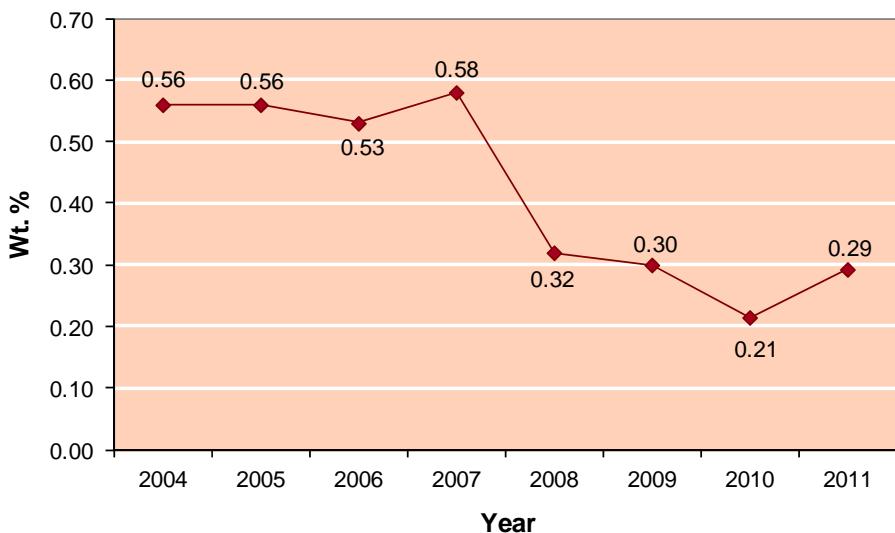
**Sulfur Content 8-Year Trend—Weighted Mean**

Figure 7-4: Sulfur Content (wt. %), 8-Year Trend, maximum 0.5

# F76 Data

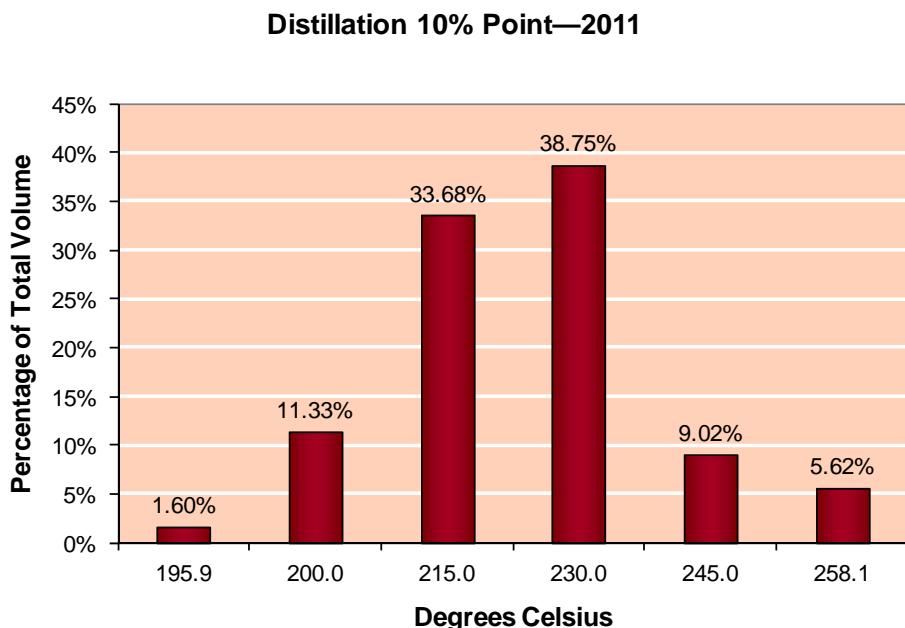


Figure 7-5: Distillation 10% Point (°C), Report

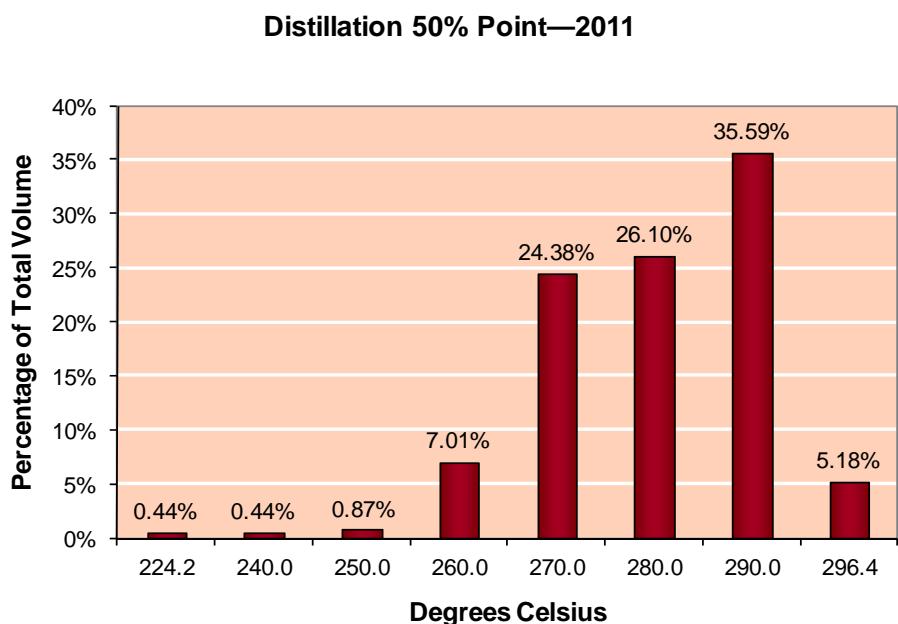


Figure 7-6: Distillation 50% Point (°C), Report

## Distillation 90% Point—2011

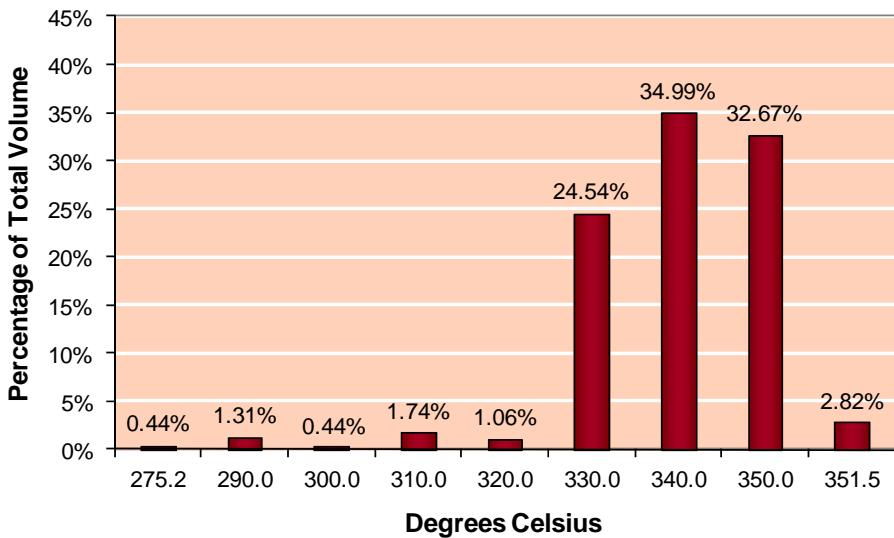


Figure 7-7: Distillation 90% Point (°C), maximum 357



# F76 Data

## Distillation End Point—2011

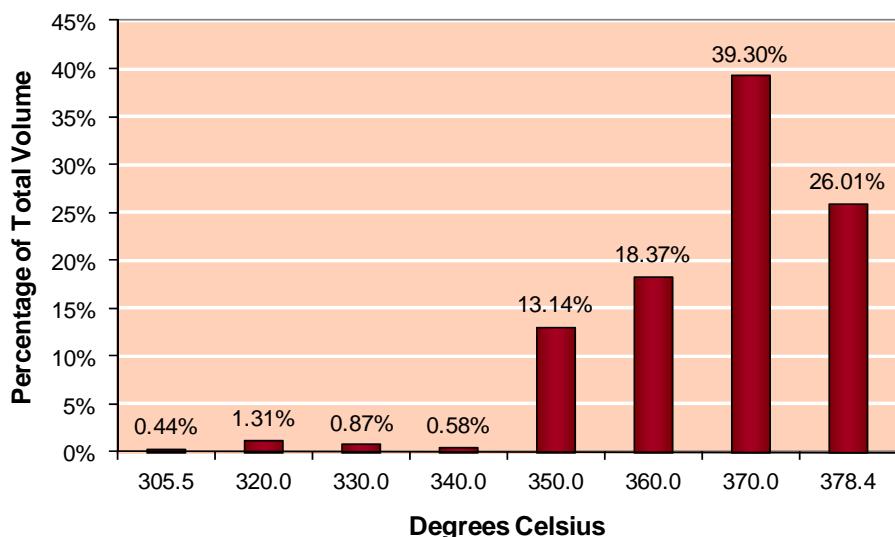


Figure 7-8: Distillation End Point ( $^{\circ}\text{C}$ ), maximum 385

## Distillation End Point 11-Year Trend—Weighted Mean

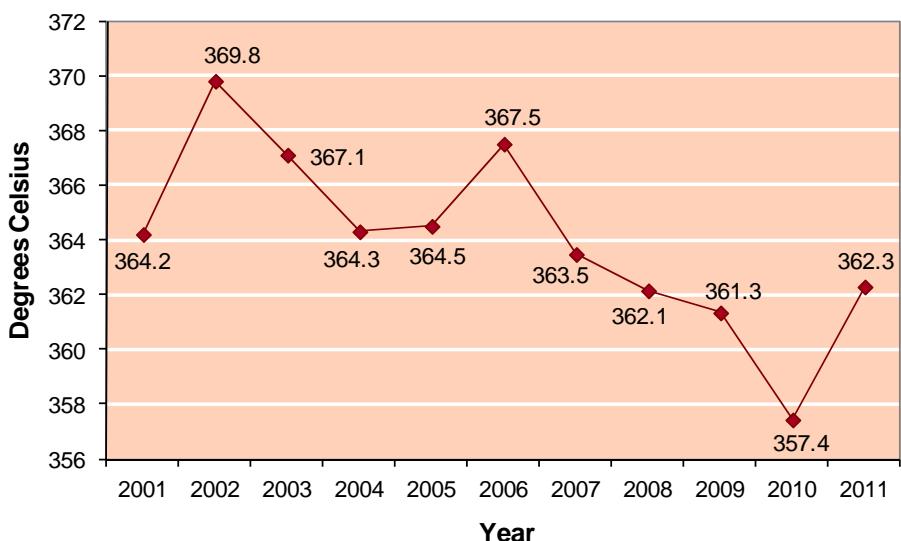


Figure 7-9: Distillation End Point ( $^{\circ}\text{C}$ ), 11-Year Trend, maximum 385

## Distillation Residue + Loss—2011

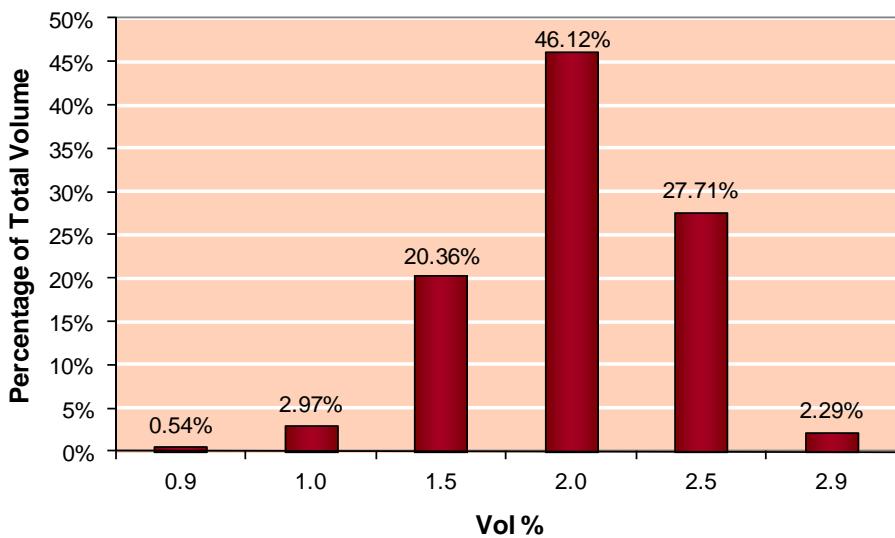


Figure 7-10: Distillation Residue + Loss (vol %), maximum 3.0



# F76 Data

## Flash Point—2011

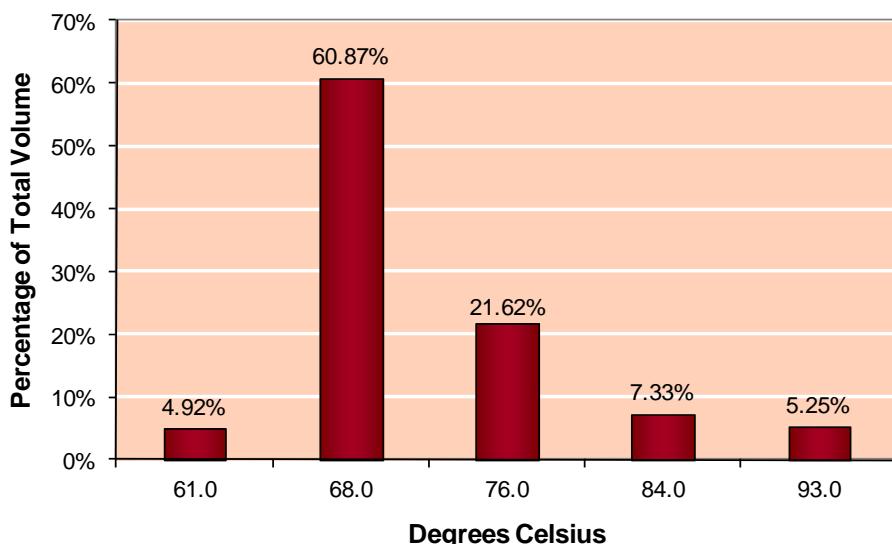


Figure 7-11: Flash Point (°C), minimum 60

## Flash Point 11-Year Trend—Weighted Mean

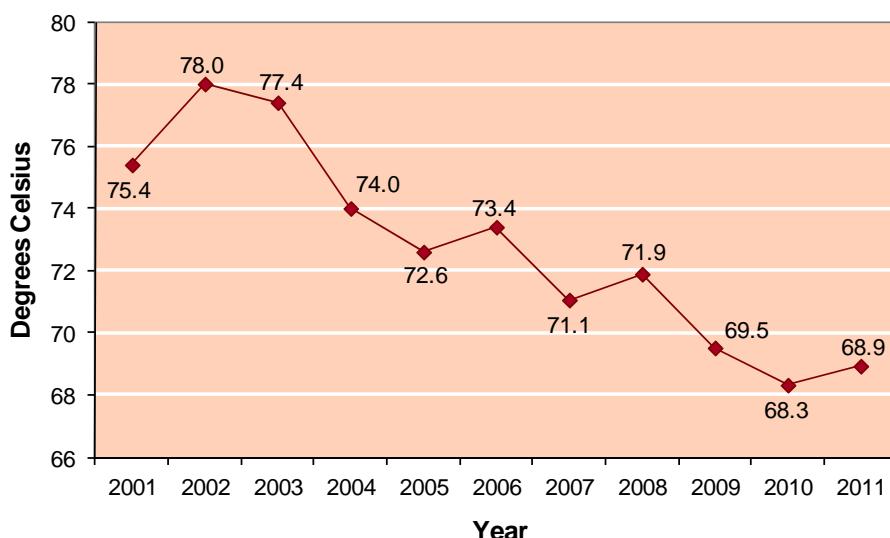
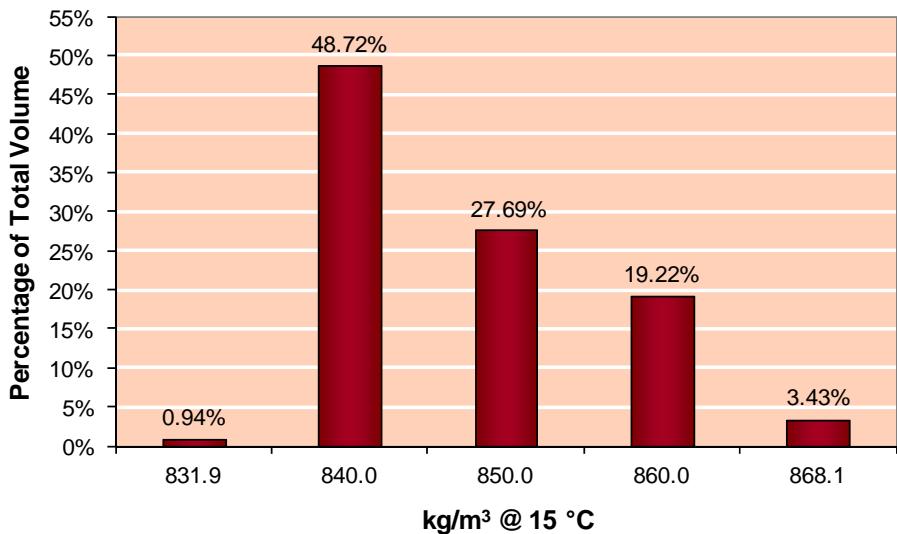
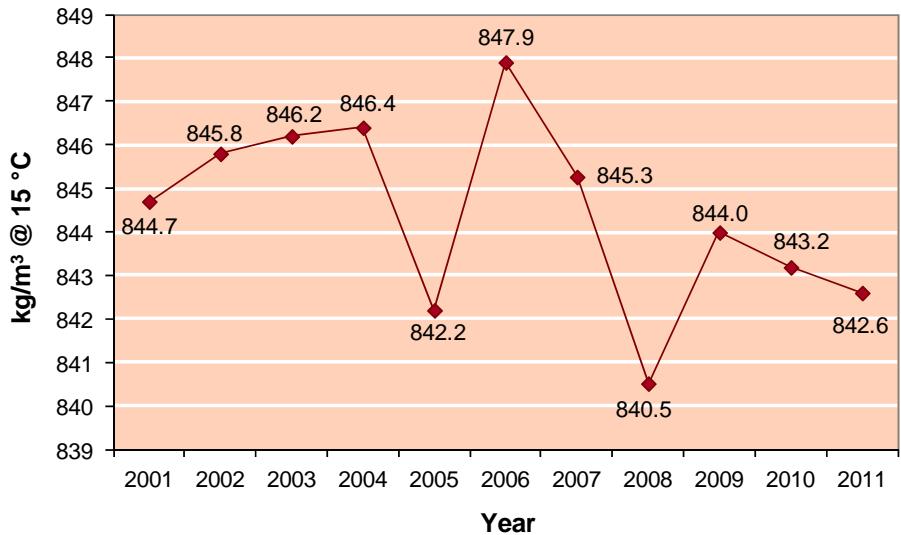


Figure 7-12: Flash Point (°C), 11-Year Trend, minimum 60

**Density—2011**Figure 7-13: Density (kg/m<sup>3</sup> @ 15 °C), maximum 876**Density 11-Year Trend—Weighted Mean**Figure 7-14: Density (kg/m<sup>3</sup> @ 15 °C), 11-Year Trend, maximum 876

# F76 Data

## Viscosity—2011

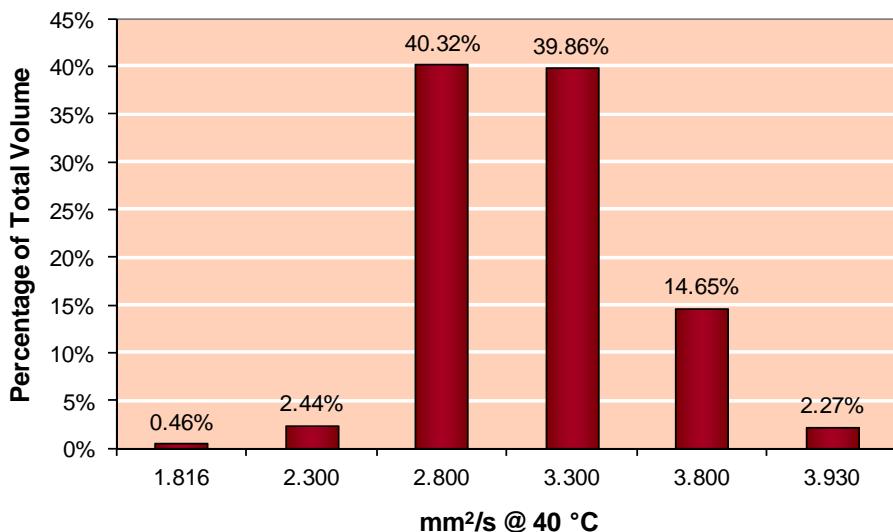


Figure 7-15: Viscosity (mm<sup>2</sup>/s @ 40 °C), minimum 1.7, maximum 4.3

## Cetane Index (Calculated)—2011

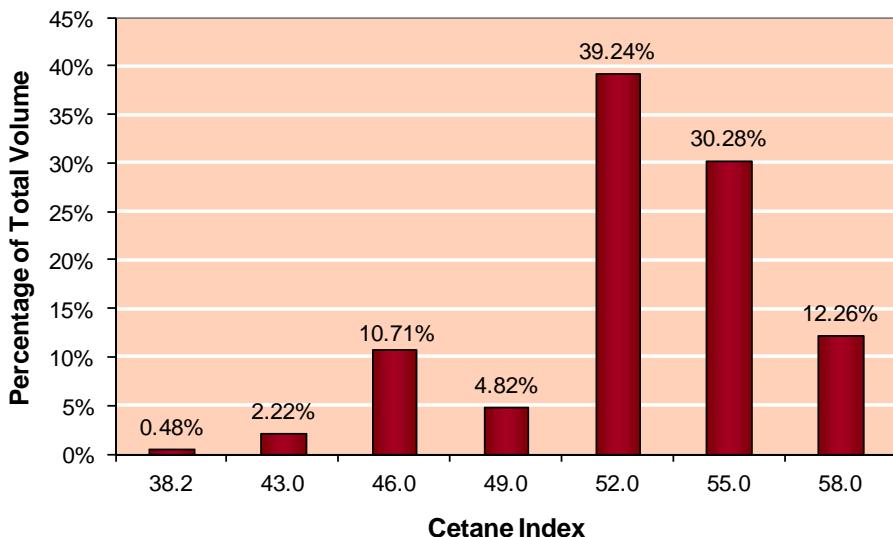


Figure 7-16: Cetane Index (Calculated), minimum 43

### Hydrogen Content—2011

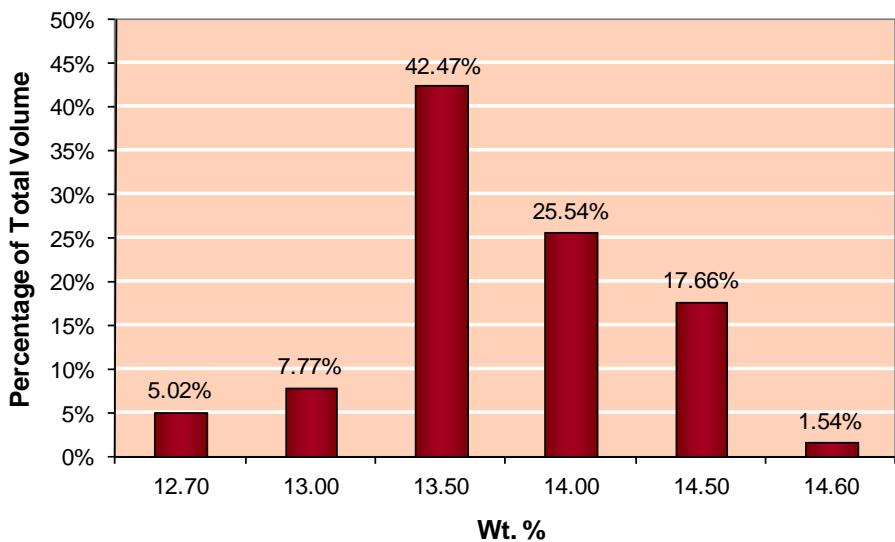


Figure 7-17: Hydrogen Content (wt. %), minimum 12.5

### Cloud Point—2011

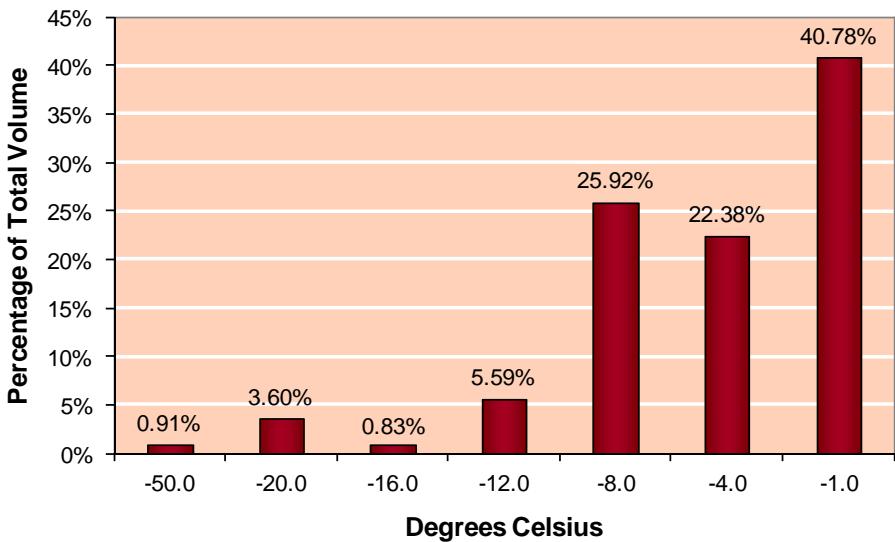


Figure 7-18: Cloud Point (°C), maximum -1

# F76 Data

## Pour Point—2011

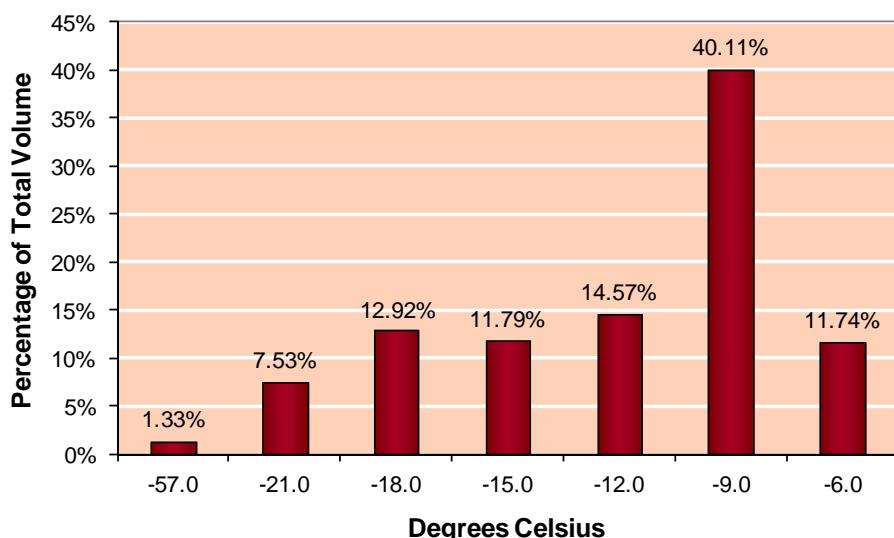


Figure 7-19: Pour Point (°C), maximum –6

## Ash—2011

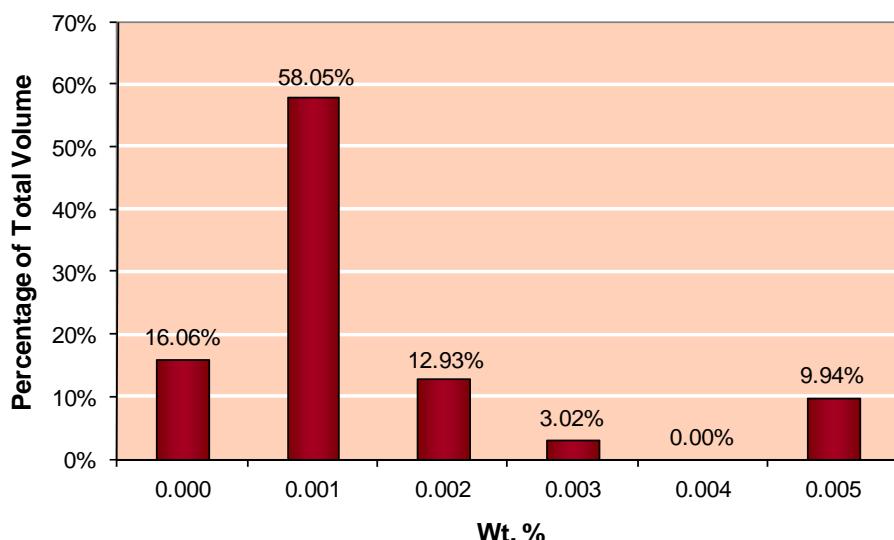


Figure 7-20: Ash (wt. %), maximum 0.005

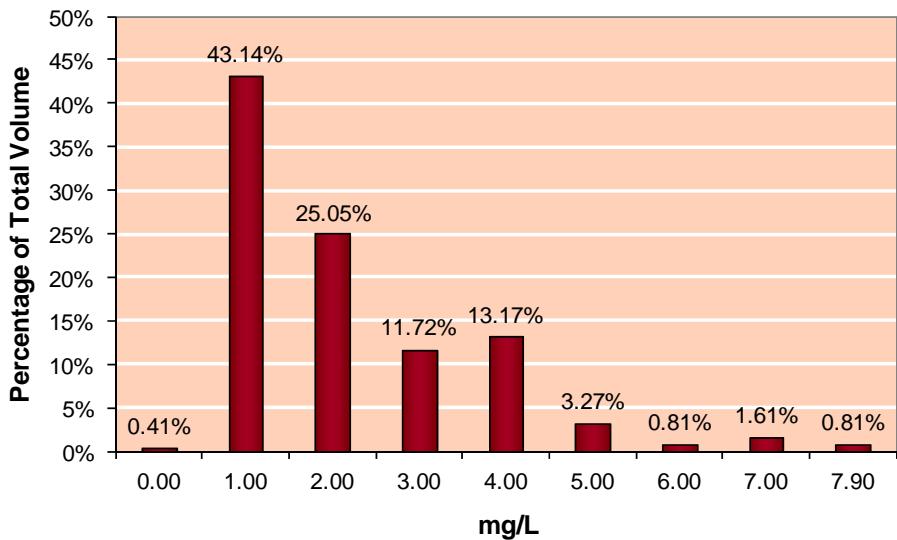
**Particulate Contamination—2011**

Figure 7-21: Particulate Contamination (mg/L), maximum 10

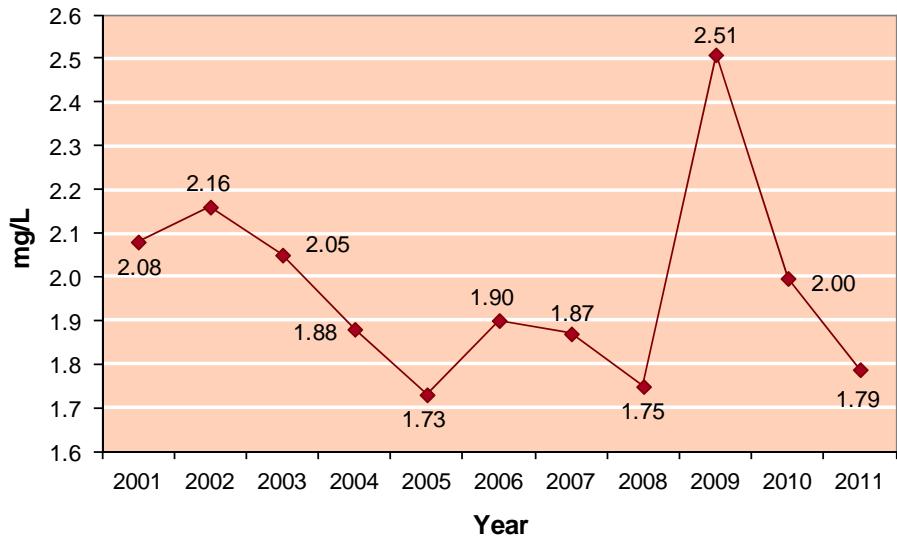
**Particulate Contamination 11-Year Trend—Weighted Mean**

Figure 7-22: Particulate Contamination (mg/L), 11-Year Trend, maximum 10

## F76 Data

**Carbon Residue on 10% Bottoms—2011  
(Method ASTM D-524)**

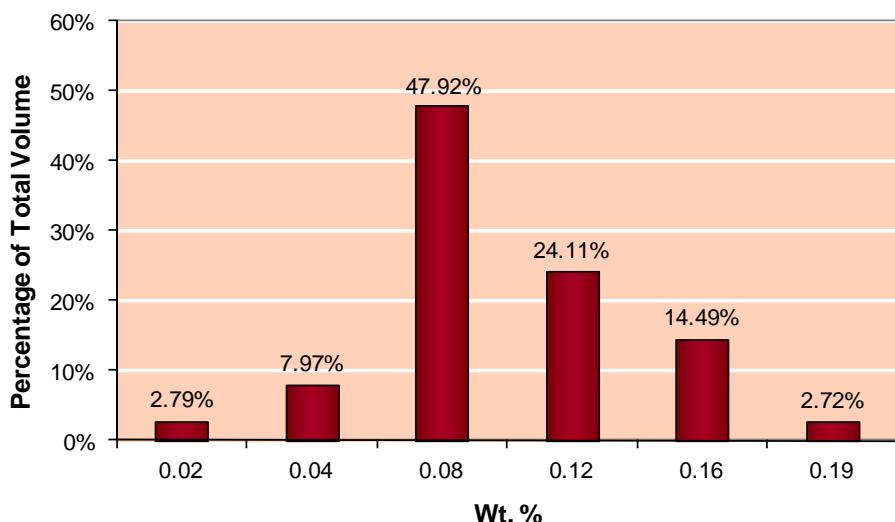


Figure 7-23: Carbon Residue on 10% Bottoms: D-524 (wt. %), maximum 0.20

**Carbon Residue on 10% Bottoms—2011  
(Methods ASTM D-189 and D-4530)**

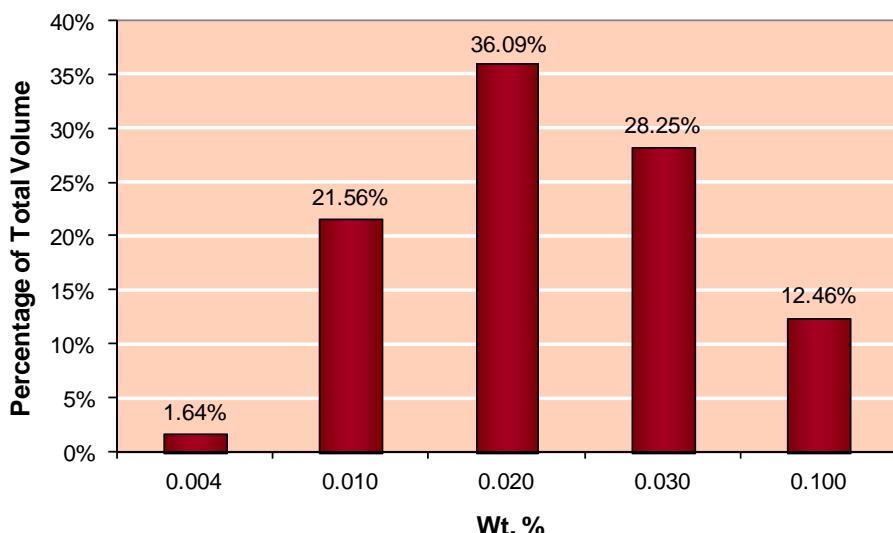


Figure 7-24: Carbon Residue on 10% Bottoms: D-189 and D-4530 (wt. %), maximum 0.14



# MGO–2011 Data Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)			
Property	2011 Source Inputs		
	Region	Volume	Batch
Cetane Index: (calculated)	All	6.709	184
Flash Point: (°C)	All	6.712	185
Pour Point: (°C)	All	6.708	183
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	All	6.709	184
Density: (kg/m <sup>3</sup> @ 15 °C)	All	6.709	184
Carbon Residue (10% Bottoms), D-4530: (mass %)	All	6.708	183
Ash: (mass%)	All	6.708	183
Sulfur: (mass %)	All	6.709	184
Oxidation Stability: (mg/100mL)	All	6.618	178
Lubricity, corrected wear scar diameter @ 60 °C: (μm)	All	6.708	183
FAME: (vol %)	All	6.656	182

Table 8-1: Data Summary, ISO-8217, Marine Gas Turbine, Grade DMA Requirements, 2011 Source Inputs

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Specification Limits		2011 Test Results			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		42.2	56.3	48.0	48.8
Flash Point: (°C)	60		18.0	110.0	67.8	68.5
Pour Point: <sup>1</sup> (°C)		-6, 0	-24.0	0.0	-17.9	-18.1
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	1.393	4.273	2.803	2.831
Density: (kg/m <sup>3</sup> @ 15 °C)		890	813.8	870.8	847.6	846.0
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.350	0.0170	0.0127
Ash: (mass%)		0.010	0.000	0.013	0.0004	0.0003
Sulfur: (mass %)		1.0	0.000032	0.4910	0.057	0.056
Oxidation Stability: (mg/100mL)		25	0.0	16.2	1.34	1.38
Lubricity, corrected wear scar diameter @ 60 °C: <sup>2</sup> (μm)		520	200.0	700.0	382.9	370.2
FAME: (vol %)		0.1	0.00	3.24	0.06	0.04

Table 8-2: Data Summary, ISO-8217, Marine Gas Turbine, Grade DMA Requirements, 2011 Test Results

**Note 1:** Pour Point winter quality maximum limit equals -6 °C, while the summer quality maximum limit equals 0 °C.

**Note 2:** Requirement is applicable to fuels with sulfur content below 0.050 mass %.

# MGO-2011 Regional Data Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		0.855			
	Batch Analysis		57			
	Specification Limits		Region 1			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		42.2	56.3	47.6	47.6
Flash Point: (°C)	60		18.0	82.0	65.1	66.5
Pour Point: (°C)		-6, 0	-21.0	-6.0	-19.4	-18.7
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	1.393	3.363	2.608	2.649
Density: (kg/m <sup>3</sup> @ 15 °C)		890	813.8	862.8	845.1	845.3
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.350	0.0191	0.0206
Ash: (mass%)		0.010	0.000	0.013	0.0005	0.0005
Sulfur: (mass %)		1.0	0.00036	0.1800	0.0166	0.0177
Oxidation Stability: (mg/100mL)		25	0.0	16.2	1.26	1.31
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	220.0	700.0	394.2	396.7
FAME: (vol %)		0.1	0.00	2.52	0.09	0.13

Table 8-3: Region 1 Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		0.620			
	Batch Analysis		30			
	Specification Limits		Region 2			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		42.6	47.2	45.0	44.6
Flash Point: (°C)	60		51.0	78.0	66.8	69.2
Pour Point: (°C)		-6, 0	-21.0	-21.0	-21.0	-21.0
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	2.229	3.177	2.618	2.585
Density: (kg/m <sup>3</sup> @ 15 °C)		890	841.4	861.9	853.1	852.6
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.050	0.0143	0.0118
Ash: (mass%)		0.010	0.000	0.007	0.0006	0.0009
Sulfur: (mass %)		1.0	0.00047	0.0309	0.0082	0.0072
Oxidation Stability: (mg/100mL)		25	0.1	2.4	0.61	0.61
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	240.0	530.0	407.3	398.8
FAME: (vol %)		0.1	0.00	0.01	0.002	0.001

Table 8-4: Region 2 Summary

# MGO–2011 Regional Data Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		0.036			
	Batch Analysis		3			
	Specification Limits		Region 3			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		47.6	52.6	49.9	49.6
Flash Point: (°C)	60		68.0	83.0	75.0	74.4
Pour Point: (°C)		-6, 0	-18.0	-9.0	-15.0	-15.6
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	2.530	3.151	2.941	2.931
Density: (kg/m <sup>3</sup> @ 15 °C)		890	837.8	852.0	844.9	845.6
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.020	0.0100	0.0111
Ash: (mass%)		0.010	0.000	0.000	0.0000	0.0000
Sulfur: (mass %)		1.0	0.000032	0.0010	0.0005	0.0005
Oxidation Stability: (mg/100mL)	25		0.1	0.4	0.23	0.25
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	270.0	310.0	286.7	284.7
FAME: (vol %)		0.1	0.00	0.00	0.00	0.00

Table 8-5: Region 3 Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		0.541			
	Batch Analysis		15			
	Specification Limits		Region 5			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		42.5	55.7	49.1	49.1
Flash Point: (°C)	60		62.0	77.0	68.5	68.4
Pour Point: (°C)		-6, 0	-21.0	-9.0	-16.8	-16.8
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	2.191	2.984	2.646	2.633
Density: (kg/m <sup>3</sup> @ 15 °C)		890	828.6	863.7	840.5	839.3
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.070	0.0153	0.0128
Ash: (mass%)		0.010	0.000	0.003	0.0005	0.0008
Sulfur: (mass %)		1.0	0.00036	0.1600	0.0282	0.0362
Oxidation Stability: (mg/100mL)	25		0.1	2.6	1.07	1.30
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	240.0	514.0	381.7	369.8
FAME: (vol %)		0.1	0.00	3.24	0.28	0.17

Table 8-6: Region 5 Summary

# MGO-2011 Regional Data Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		2.763			
	Batch Analysis		25			
	Specification Limits		Region 8			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		45.3	55.6	50.3	50.1
Flash Point: (°C)	60		61.8	110.0	72.4	68.8
Pour Point: (°C)		-6, 0	-24.0	-9.0	-18.2	-19.4
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	2.390	3.766	3.048	2.799
Density: (kg/m <sup>3</sup> @ 15 °C)		890	832.3	856.0	846.1	843.1
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.030	0.0092	0.0060
Ash: (mass%)		0.010	0.000	0.002	0.0002	0.0001
Sulfur: (mass %)		1.0	0.00027	0.3600	0.0436	0.0136
Oxidation Stability: (mg/100mL)		25	0.1	4.8	1.20	1.09
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	280.0	514.0	387.9	377.2
FAME: (vol %)		0.1	0.00	0.21	0.03	0.01

Table 8-7: Region 8 Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		0.336			
	Batch Analysis		15			
	Specification Limits		Region 9			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		43.9	51.6	47.4	47.5
Flash Point: (°C)	60		62.0	89.8	69.7	70.4
Pour Point: (°C)		-6, 0	-24.0	-9.0	-19.6	-20.0
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	2.321	4.076	2.811	2.817
Density: (kg/m <sup>3</sup> @ 15 °C)		890	839.7	870.8	850.1	849.6
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.080	0.0213	0.0244
Ash: (mass%)		0.010	0.000	0.001	0.0004	0.0004
Sulfur: (mass %)		1.0	0.00056	0.3550	0.0788	0.0582
Oxidation Stability: (mg/100mL)		25	0.1	4.5	1.97	2.55
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	220.0	532.0	374.8	369.0
FAME: (vol %)		0.1	0.00	0.22	0.03	0.01

Table 8-8: Region 9 Summary

# MGO–2011 Regional Data Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		1.529			
	Batch Analysis		38			
	Specification Limits		Region 10			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		45.3	55.4	49.1	48.9
Flash Point: (°C)	60		60.0	75.0	68.1	68.3
Pour Point: (°C)		-6, 0	-21.0	0.0	-13.1	-14.0
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	2.137	4.273	3.118	3.152
Density: (kg/m <sup>3</sup> @ 15 °C)		890	827.1	869.3	849.7	850.5
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.000	0.080	0.0197	0.0177
Ash: (mass%)		0.010	0.000	0.003	0.0002	0.0002
Sulfur: (mass %)		1.0	0.00077	0.4910	0.1695	0.1829
Oxidation Stability: (mg/100mL)		25	0.2	9.0	1.94	1.97
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	200.0	570.0	356.7	334.5
FAME: (vol %)		0.1	0.00	0.28	0.02	0.01

Table 8-9: Region 10 Summary

Commercial Marine Gas Oil Minimum Specification Requirements (ISO-8217, Marine Gas Turbine, Grade DMA)						
Property	Total Volume		0.023			
	Batch Analysis		1			
	Specification Limits		Region 11			
	Min	Max	Min	Max	Mean	Wt Mean
Cetane Index: (calculated)	40		50.2	50.2	50.2	50.2
Flash Point: (°C)	60		66.0	66.0	66.0	66.0
Pour Point: (°C)		-6, 0	-21.0	-21.0	-21.0	-21.0
Kinematic Viscosity: (mm <sup>2</sup> /s @ 40 °C)	2.000	6.000	3.545	3.545	3.545	3.545
Density: (kg/m <sup>3</sup> @ 15 °C)		890	853.2	853.2	853.2	853.2
Carbon Residue (10% Bottoms), D-4530: (mass %)		0.30	0.010	0.010	0.010	0.010
Ash: (mass%)		0.010	0.001	0.001	0.001	0.001
Sulfur: (mass %)		1.0	0.0150	0.0150	0.0150	0.0150
Oxidation Stability: (mg/100mL)		25	4.2	4.2	4.20	4.20
Lubricity, corrected wear scar diameter @ 60 °C: (μm)		520	289.0	289.0	289.0	289.0
FAME: (vol %)		0.1	0.12	0.12	0.12	0.12

Table 8-10: Region 11 Summary

# MGO—Assessment Summary

## ***Overview:***

MGO is continued for 2011, providing a detailed summary of test data by region. Histograms are provided for 2011 data only and were obtained solely from the PQIS database. Where significant trends were noted in weighted mean values, trend graphs were developed, providing a previous 11-year review.

The Coast Guard In-Line Sampling Program data represent dockside and vessel sampling for Ships' Bunkers program deliveries and open market purchases of MGO from various worldwide locations. Data provided were compared with ISO-8217 Grade DMA requirements and MIL-DTL-16884 criteria. The In-Line Sampling Program figures featured are based on these correlations and represent total analysis by year and the range of test failure occurrences for Calendar Year (CY) 2011 compared with these standards.

## ***Significant Trending:***

**Cetane Index (calculated).** The weighted mean increased 1.5 from 2007 to 2011.

**Kinematic Viscosity.** Aside from a slight increase from 2005 to 2006, the weighted mean decreased 0.663 mm<sup>2</sup>/s @ 40 °C from 2004 to 2011.

**Density.** The weighted mean decreased 8.3 kg/m<sup>3</sup> @ 15 °C from 2007 to 2011.

**Sulfur.** The weighted mean decreased 0.089 mass % from 2010 to 2011.

## ***MGO Observations:***

The following review applies only to In-Line Sampling Program activity critical test failure occurrences compared with ISO-8217 Grade DMA requirements and any additional Commercial Marine Gas Oil Minimum Specification requirements (DLA Energy Oct 2010):

**Cetane Index.** Zero failure occurrences were noted during CY 2011. This represents a 0.0 percent failure rate on the basis of the 184 samples tested.

**Flash Point.** Six failure occurrences were noted during CY 2011. This represents a 3.2 percent failure rate on the basis of the 185 samples tested.

# MGO—Assessment Summary

**Pour Point.** Zero failure occurrences were noted during CY 2011. This represents a 0.0 percent failure rate on the basis of the 183 samples tested.

**Kinematic Viscosity.** Two failure occurrences were noted during CY 2011. This represents a 1.1 percent failure rate on the basis of the 184 samples tested.

**Density.** Zero failure occurrences were noted during CY 2011. This represents a 0.0 percent failure rate on the basis of the 184 samples tested.

**Carbon Residue, 10% btm (ASTM D4530).** One failure occurrence was noted during CY 2011. This represents a 0.5 percent failure rate on the basis of the 183 samples tested.

**Ash.** One failure occurrence was noted during CY 2011. This represents a 0.5 percent failure rate on the basis of the 183 samples tested.

**Sulfur.** Zero failure occurrences were noted during CY 2011. This represents a 0.0 percent failure rate on the basis of the 184 samples tested.

**Acid Number.** Zero failure occurrences were noted during CY 2011. This represents a 0.0 percent failure rate on the basis of the 182 samples tested.

**Appearance.** Thirteen failure occurrences were noted during CY 2011. This represents a 7.1 percent failure rate on the basis of the 182 samples tested.

**Oxidation Stability.** Zero failure occurrences were noted during CY 2011. This represents a 0.0 percent failure rate on the basis of the 178 samples tested.

**Lubricity.** Eight failure occurrences were noted during CY 2011. This represents a 4.4 percent failure rate on the basis of the 183 samples tested.

**Fatty Acid Methyl Esters (FAME).** Seventeen failure occurrences were noted during CY 2011. This represents a 9.3 percent failure rate on the basis of the 182 samples tested.

Although the ISO-8217 Grade DMA requirements specify a 1.5 mass % maximum limit for sulfur and do not include FAME, per Commercial Marine Gas Oil Minimum Specification Requirements (DLA Energy Oct 2010), the maximum limit for sulfur is 1.0 mass % and the maximum limit for FAME is 0.1 vol %.

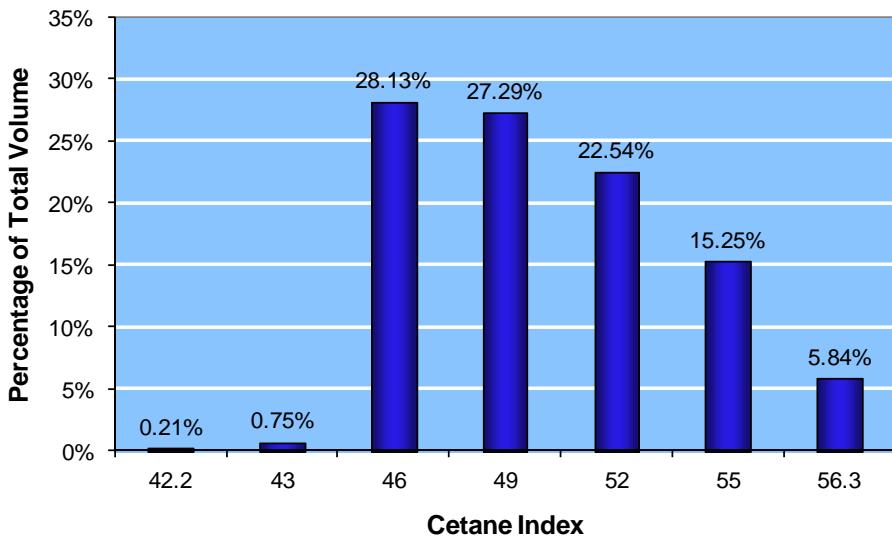
**Cetane Index (Calculated)—2011**

Figure 8-1: Cetane Index (calculated), minimum 40

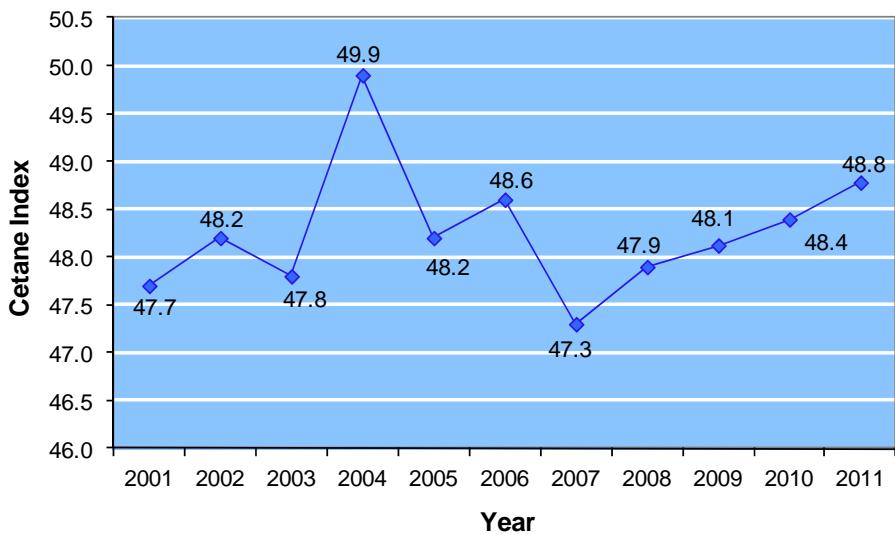
**Cetane Index 11-Year Trend—Weighted Mean**

Figure 8-2: Cetane Index (calculated), 11-Year Trend, minimum 40

## Flash Point—2011

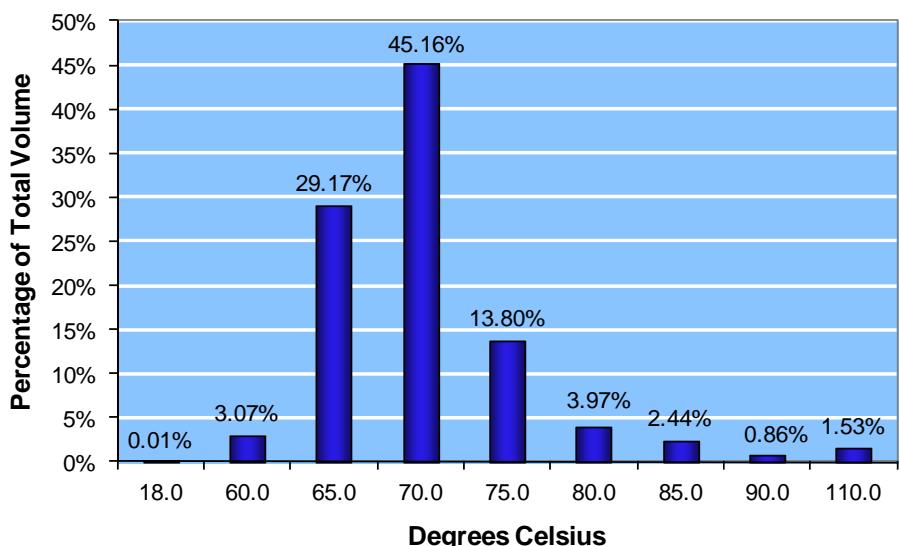


Figure 8-3: Flash Point (°C), minimum 60

## Pour Point—2011

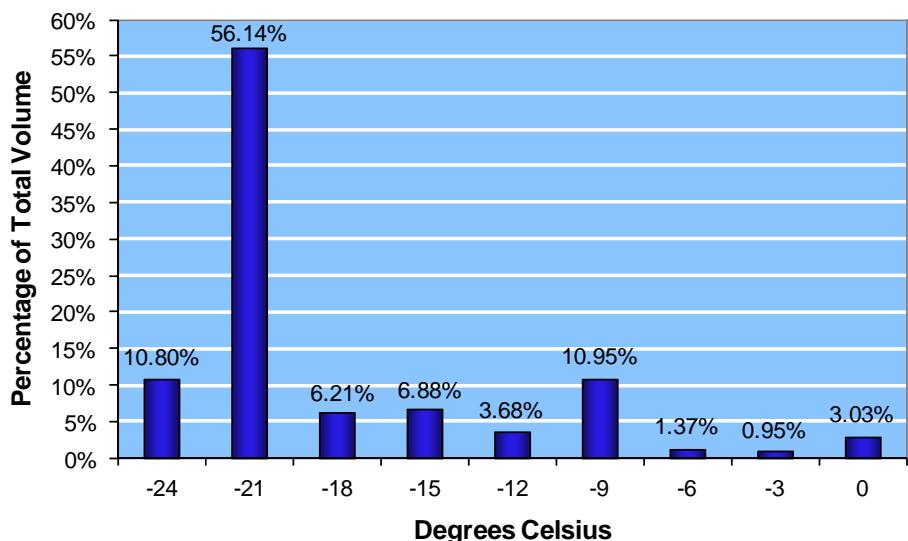


Figure 8-4: Pour Point (°C), maximum -6 (winter quality) or 0 (summer quality)

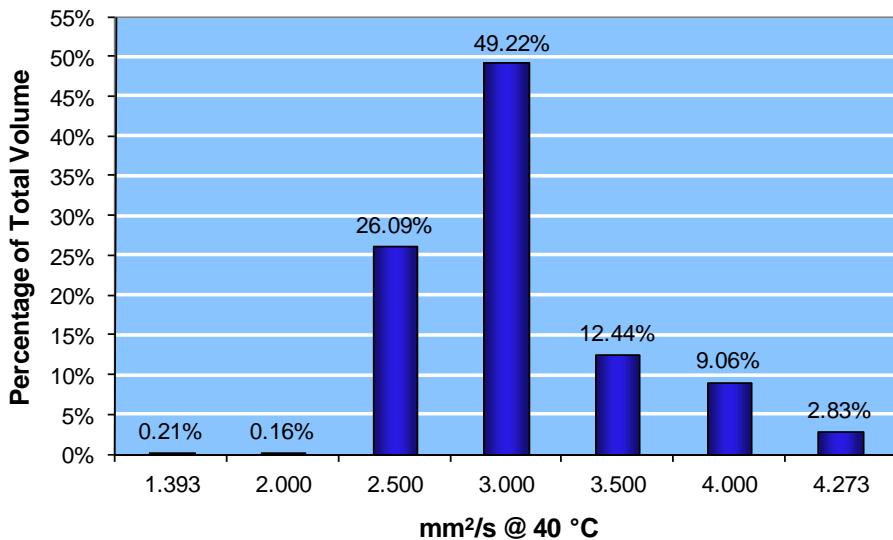
**Kinematic Viscosity—2011**

Figure 8-5: Kinematic Viscosity (mm<sup>2</sup>/s @ 40 °C), minimum 2.000, maximum 6.000

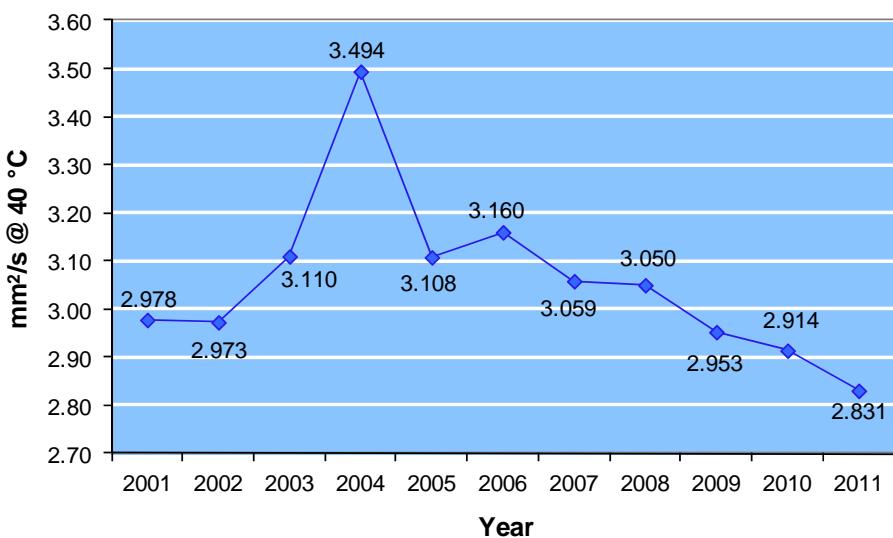
**Kinematic Viscosity 11-Year Trend—Weighted Mean**

Figure 8-6: Kinematic Viscosity (mm<sup>2</sup>/s @ 40 °C), 11-Year Trend, minimum 2.000, maximum 6.000

# MGO Data

## Density—2011

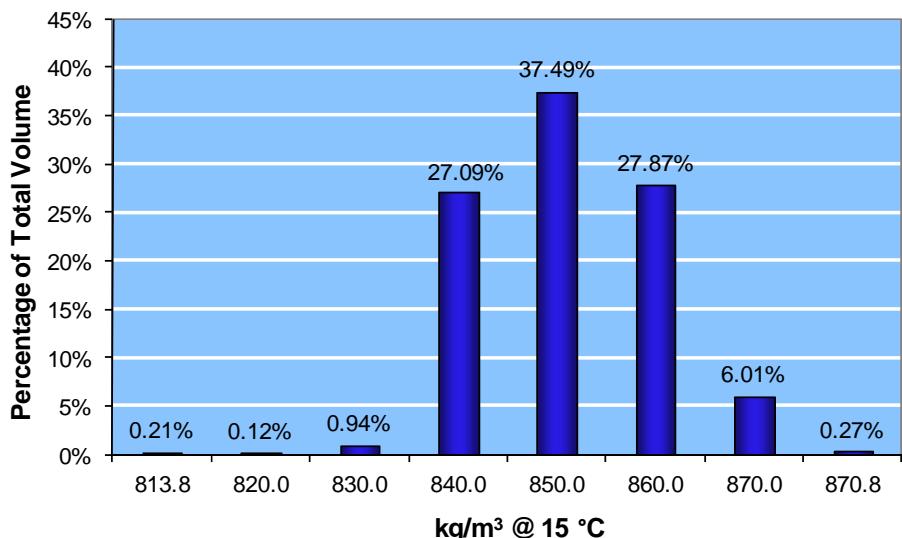


Figure 8-7: Density (kg/m<sup>3</sup> @ 15 °C), maximum 890

## Density 11-Year Trend—Weighted Mean

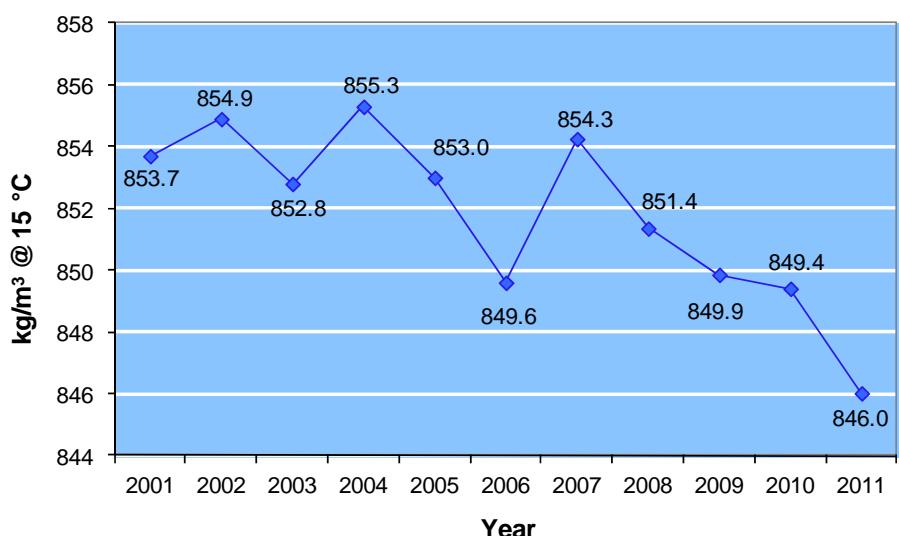


Figure 8-8: Density (kg/m<sup>3</sup> @ 15 °C), 11-Year Trend, maximum 890

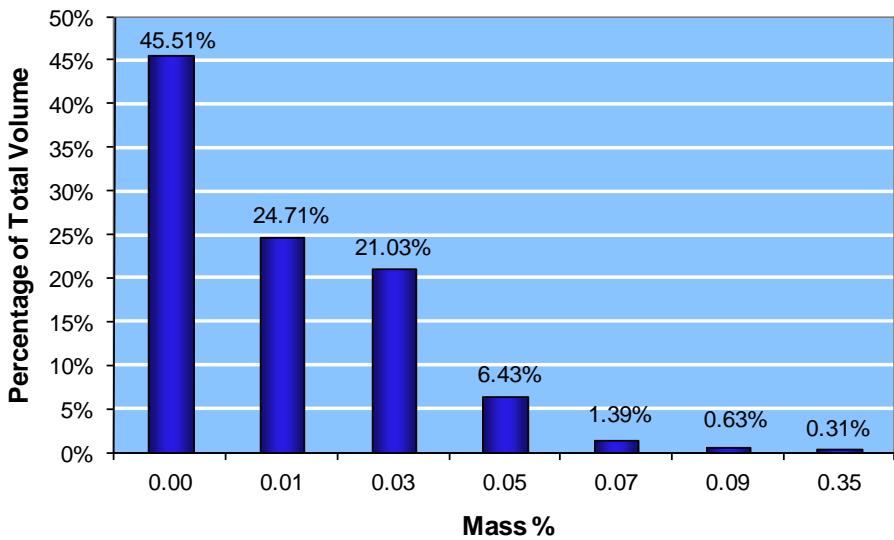
**Carbon Residue (10% Bottoms), ASTM D4530—2011**

Figure 8-9: Carbon Residue (10% Bottoms), D-4530 (mass %), maximum 0.30

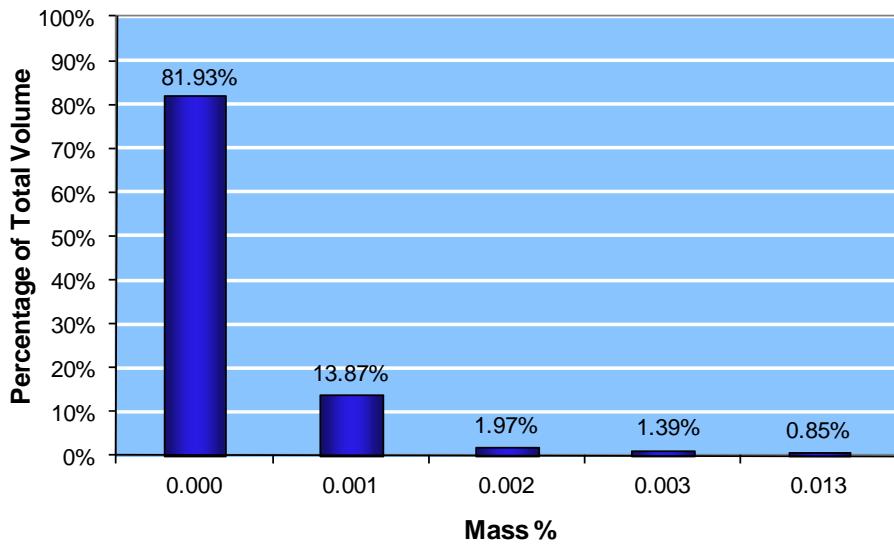
**Ash—2011**

Figure 8-10: Ash (mass %), maximum 0.010

# MGO Data

## Sulfur—2011

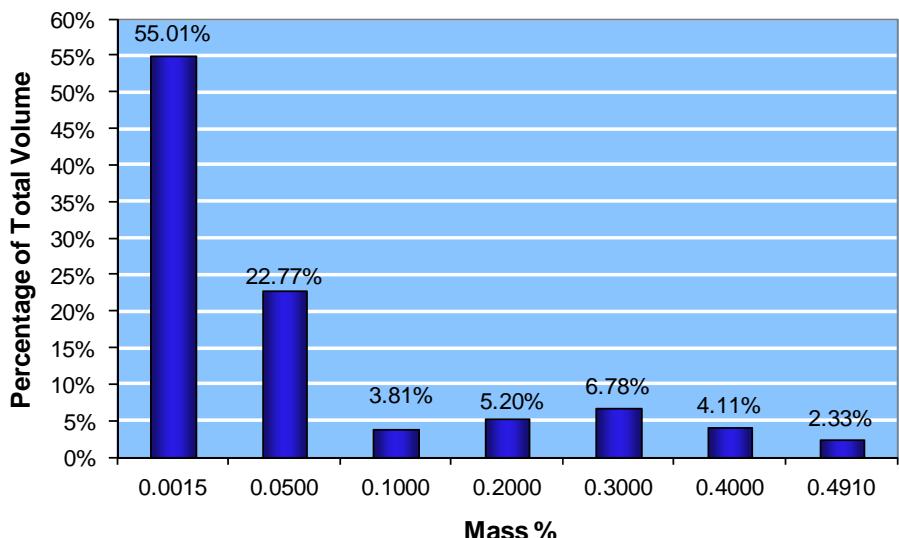


Figure 8-11: Sulfur (mass %), maximum 1.0

## Sulfur 11-Year Trend—Weighted Mean

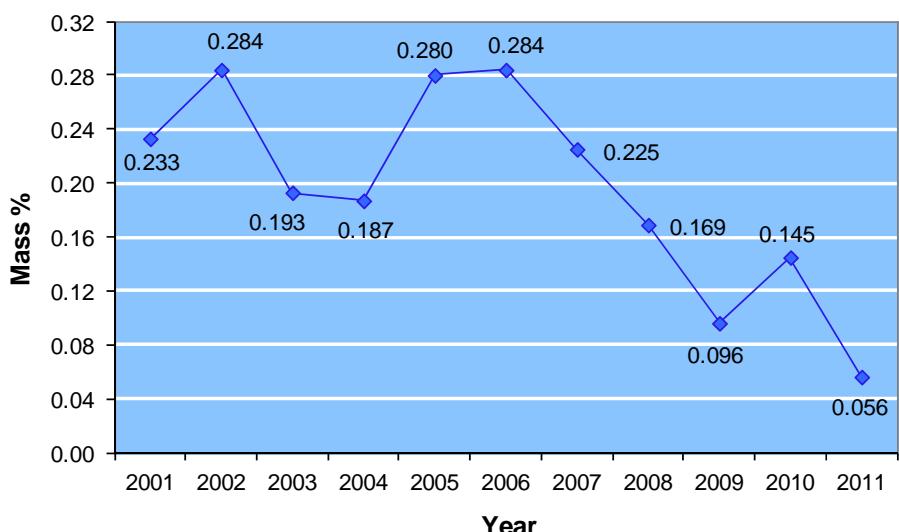


Figure 8-12: Sulfur (mass %), 11-Year Trend, maximum 1.0

**Note:** Per Commercial Marine Gas Oil Minimum Specification Requirements (DLA Energy Oct 2010), the sulfur maximum limit is 1.0 mass %.

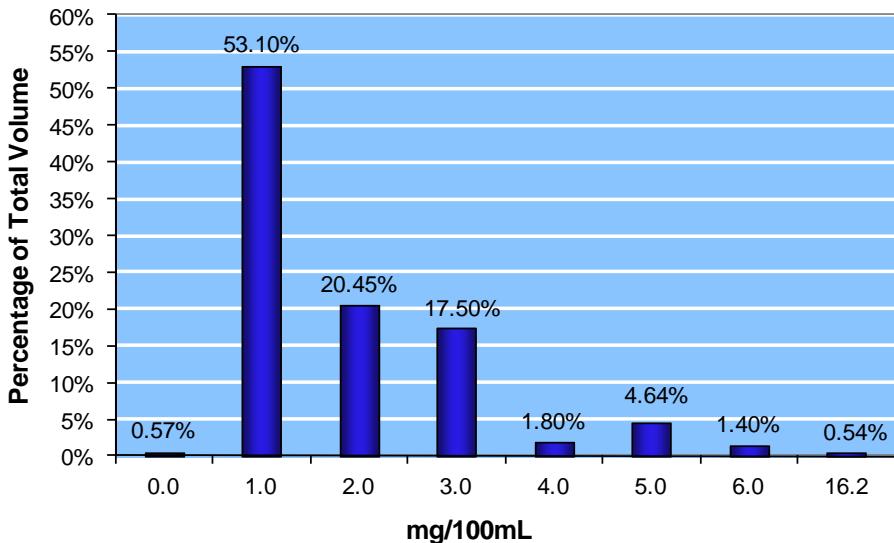
**Oxidation Stability—2011**

Figure 8-13: Oxidation Stability (mg/100 mL), maximum 25

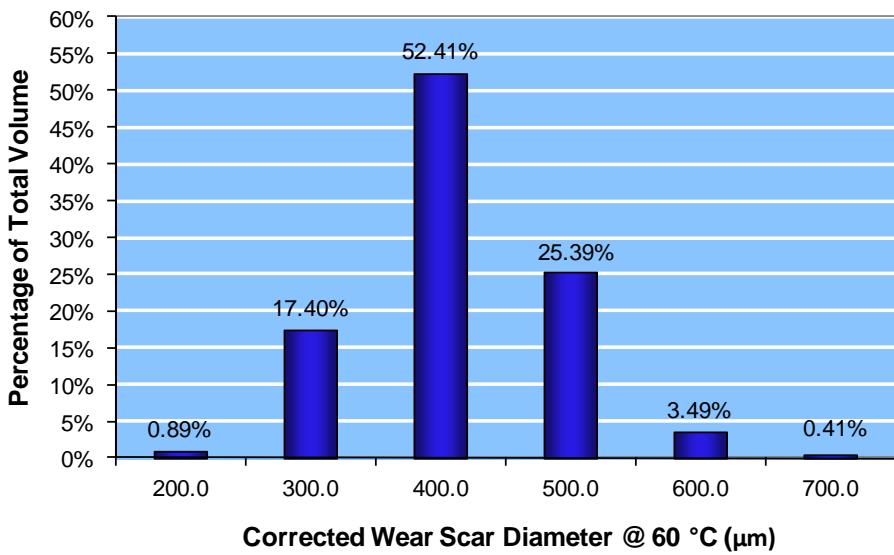
**Lubricity—2011**

Figure 8-14: Lubricity, corrected wear scar diameter @ 60 °C (µm), maximum 520

**Note:** The lubricity requirement is applicable to fuels with sulfur content below 0.050 mass %.

# MGO Data

## FAME—2011

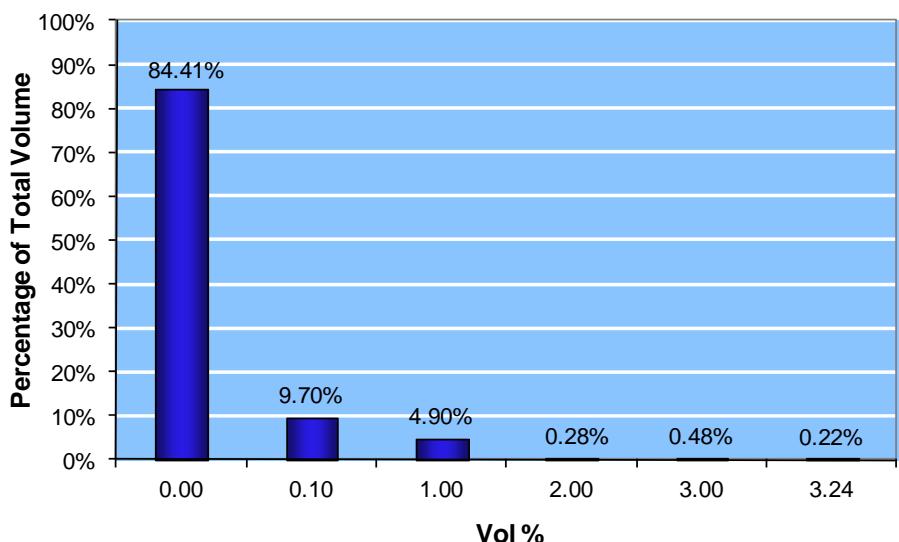


Figure 8-15: FAME (vol %), maximum 0.1

**Note:** Per Commercial Marine Gas Oil Minimum Specification Requirements (DLA Energy Oct 2010), the FAME maximum limit is 0.1 vol %.



# MGO—In-Line Sampling Program

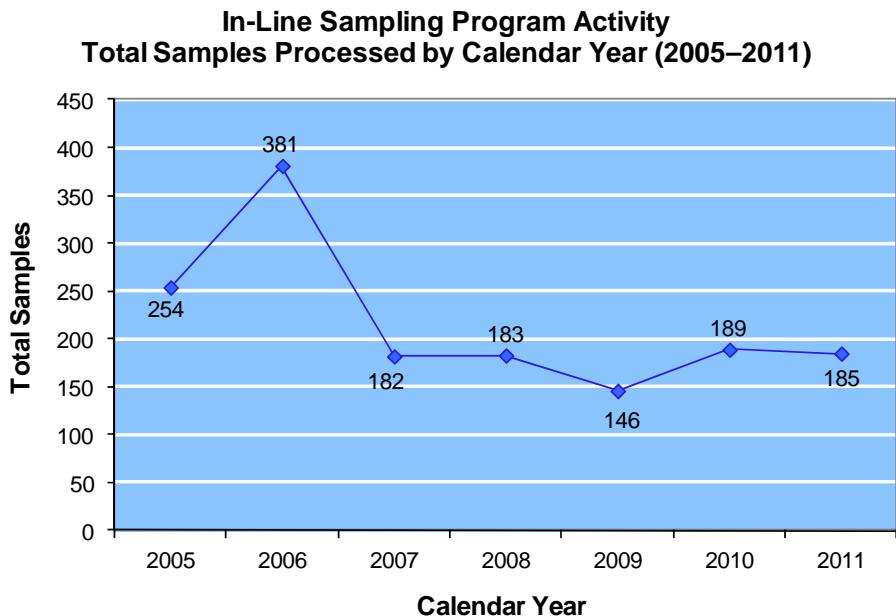


Figure 8-16: In-Line Sampling Program Activity, Total Samples Processed, CY 2005–CY 2011

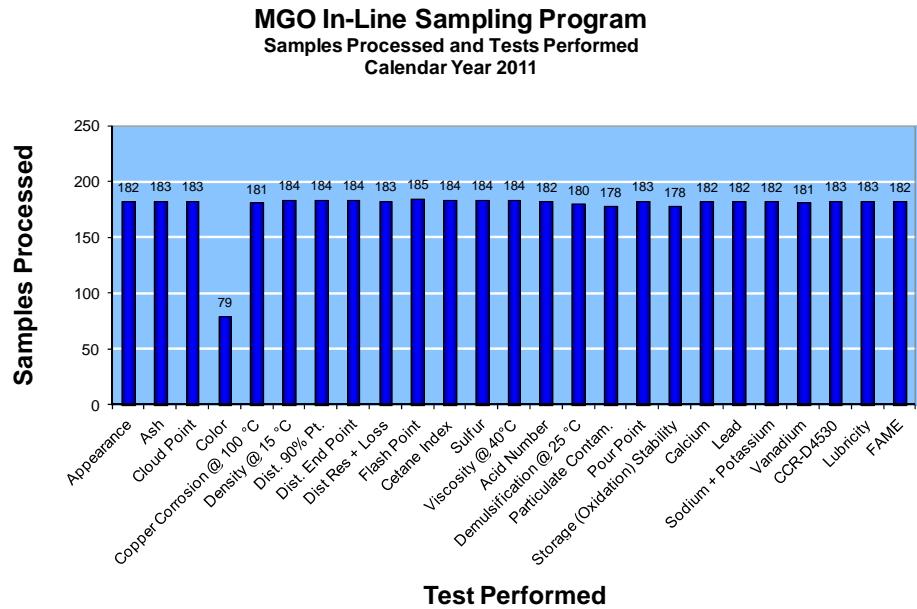


Figure 8-17: In-Line Sampling Program, Samples Processed and Tests Performed, CY 2011

# MGO—In-Line Sampling Program

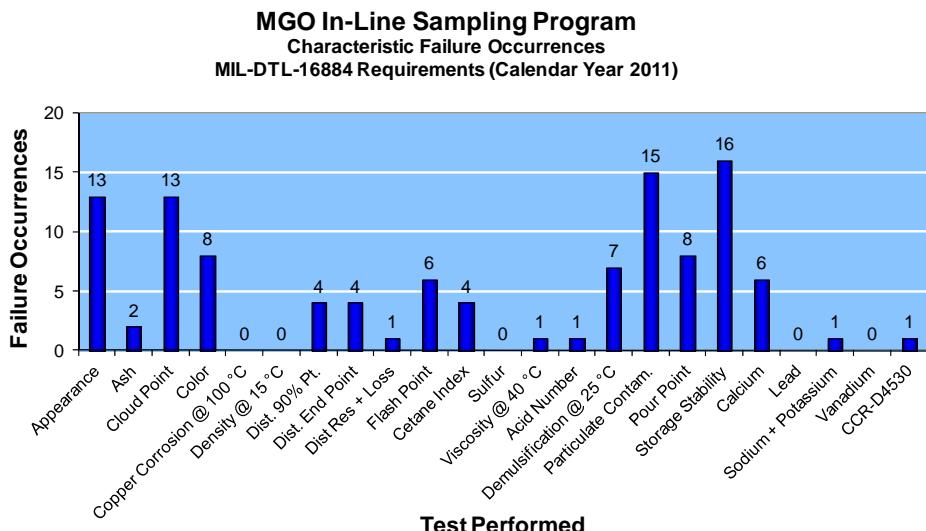


Figure 8-18: MGO In-Line Sampling Program, Characteristic Failure Occurrences, MIL-DTL-16884 Requirements, CY 2011

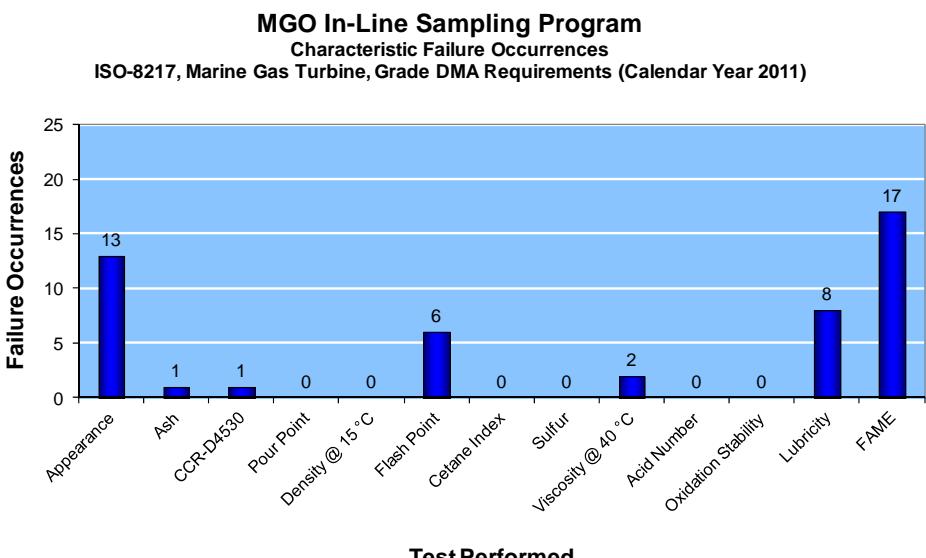


Figure 8-19: MGO In-Line Sampling Program, Characteristic Failure Occurrences, ISO-8217, Marine Gas Turbine, Grade DMA Requirements, CY 2011

**Note:** Per Commercial Marine Gas Oil Minimum Specification Requirements (DLA Energy Oct 2010), the sulfur maximum limit is 1.0 mass % and the FAME Content maximum limit is 0.1 vol %.



# TS1–2011 Data Summary

Turbine Fuel, Aviation, TS1 Russian Grade, GOST 10227-86			
Property	2011 Source Inputs		
	Region	Volume	Batch
<b>Density:</b>			
kg/m <sup>3</sup> @ 20 °C	8	NR	93
kg/m <sup>3</sup> @ 15 °C	8	NR	NR
<b>Fractional composition:</b> (Distillation)			
Temperature at start (IBP) (°C)	8	NR	95
10% recovered, (°C)	8	NR	95
50% recovered, (°C)	8	NR	95
90% recovered, (°C)	8	NR	95
98% recovered, (°C)	8	NR	90
<b>Viscosity:</b>			
mm <sup>2</sup> /s (cSt) @ 20 °C	8	NR	79
mm <sup>2</sup> /s (cSt) @ -40 °C	8	NR	76
mm <sup>2</sup> /s (cSt) @ -20 °C	8	NR	33
<b>Estimate of Heat Value:</b> (kJ/kg)	8	NR	92
<b>Height of Non-smoking Flame:</b> (mm)	8	NR	93
<b>Acidity:</b> (mg KOH/100cm <sup>3</sup> )	8	NR	94
<b>Flash Point:</b> (°C)	8	NR	94
<b>Temperature of crystallization:</b> (°C)	8	NR	93
<b>Aromatics:</b> (vol%)	8	NR	91
<b>Concentration of resins:</b> (mg/100cm <sup>3</sup> )	8	NR	5
<b>Sulfur, Mercaptan:</b> (mass %)	8	NR	73
<b>Sulfur, Total:</b> (mass %)	8	NR	79
<b>Ash Quantity:</b> (mass %)	8	NR	NR

Table 9-1: Data Summary, Turbine Fuel, Aviation, TS1 Russian Grade, GOST 10227-86, 2011 Source Inputs

# TS1-2011 Data Summary

Turbine Fuel, Aviation, TS1 Russian Grade, GOST 10227-86					
Property	Specification Limits (TC-1)		2011 Test Results		
	Min	Max	Min	Max	Mean
<b>Density:</b>					
kg/m <sup>3</sup> @ 20 °C	775		783.4	800.8	791.3
kg/m <sup>3</sup> @ 15 °C		Report	NR	NR	NR
<b>Fractional composition: (Distillation)</b>					
Temperature at start (IBP) (°C)		150	138.0	151.0	144.1
10% recovered, (°C)		165	151.0	175.0	161.4
50% recovered, (°C)		195	172.0	199.0	185.3
90% recovered, (°C)		230	196.0	228.0	213.7
98% recovered, (°C)		250	207.0	251.0	231.0
<b>Viscosity:</b>					
mm <sup>2</sup> /s (cSt) @ 20 °C	1.25		1.270	1.623	1.435
mm <sup>2</sup> /s (cSt) @ -40 °C		8.0	3.210	6.890	5.761
mm <sup>2</sup> /s (cSt) @ -20 °C		Report	1.480	3.988	2.558
<b>Estimate of Heat Value: (kJ/kg)</b>	42,900		43,127	43,781	43,277
<b>Height of Non-smoking Flame: (mm)</b>	25.0		25.0	35.0	25.8
<b>Acidity: (mg KOH/100cm<sup>3</sup>)</b>		0.7	0.003	0.680	0.281
<b>Flash Point: (°C)</b>	28.0		32.0	44.0	37.5
<b>Temperature of crystallization: (°C)</b>		-50	-60.0	-51.0	-57.0
<b>Aromatics: (vol%)</b>		22.0	10.00	18.30	14.11
<b>Concentration of resins: (mg/100cm<sup>3</sup>)</b>		5	0.80	3.00	1.76
<b>Sulfur, Mercaptan: (mass %)</b>		0.005	0.0000	0.0026	0.0011
<b>Sulfur, Total: (mass %)</b>		0.25	0.0001	0.0510	0.030
<b>Ash Quantity: (mass %)</b>		0.003	NR	NR	NR

Table 9-2: Data Summary, Turbine Fuel, Aviation, TS1 Russian Grade, GOST 10227-86, 2011 Test Results

# TS1—Assessment Summary

## ***Overview:***

Turbine Fuel, Aviation, TS1, Russian Grade was a newly featured product reported for the 2006 procurement year. Due to lack of reporting, TS1 was not included in the 2008 and 2009 PQIS annual reports, but it was once again incorporated in the 2010 report. For the 2011 procurement year, 95 batches were reported by Region 8 and recorded in the PQIS. The USSR State Standard Jet Fuels specification, GOST 10277-86, Grade TC-1, First Category of Quality, governs the procurement parameters for TS1 and they are presented accordingly.

The results presented in this chapter in the form of histograms correlate to the minimum and maximum table of specifications consistent with the previously described standard.

TS1 is being supplied in Afghanistan for the operational sustainment of forces committed in the region. TS1 is procured “neat” (containing no additives). Russian additives are not approved for use in U.S. aircraft and equipment. Approved additives may be added downstream as required or appropriate for end use.

Product quantities for TS1 were not recorded in the 2011 procurement year. For this reason, weighted mean results for this product cannot be shown.

## ***TS1 Observations:***

All batches met specification requirements for 2011.

Although some distillation temperatures fell outside of the specification limits, waivers have been issued throughout the year to accept Jet A-1 specification fuel in lieu of TS1 at certain locations. Distillation point values above the maximum specification limits are all covered under waivers.

**Note:** When reading the histograms for TS1, the far left bar represents the percentage of analyses associated with the minimum data value. Any other bar represents the percentage of analyses greater than the data value of the bar to the immediate left of it, up to and including the value of that bar.

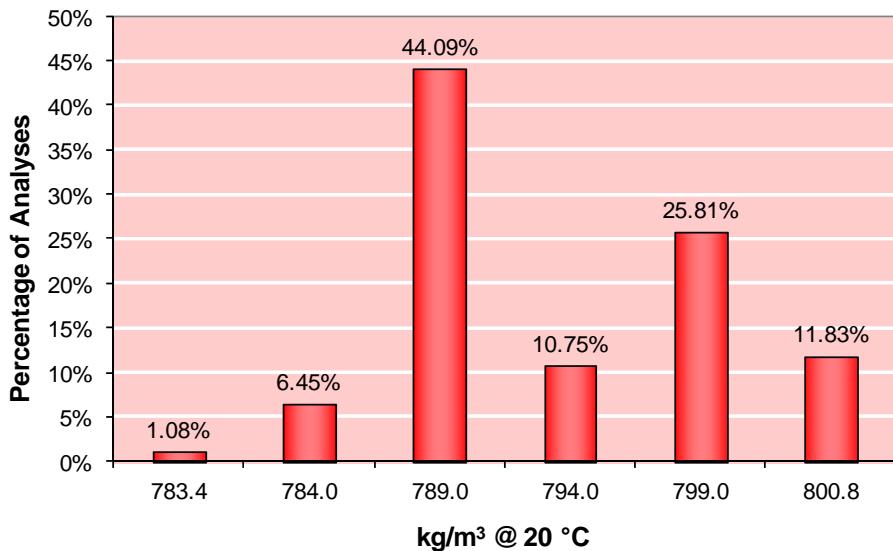
**Density @ 20 °C—2011**

Figure 9-1: Density (kg/m<sup>3</sup> @ 20 °C), minimum 775

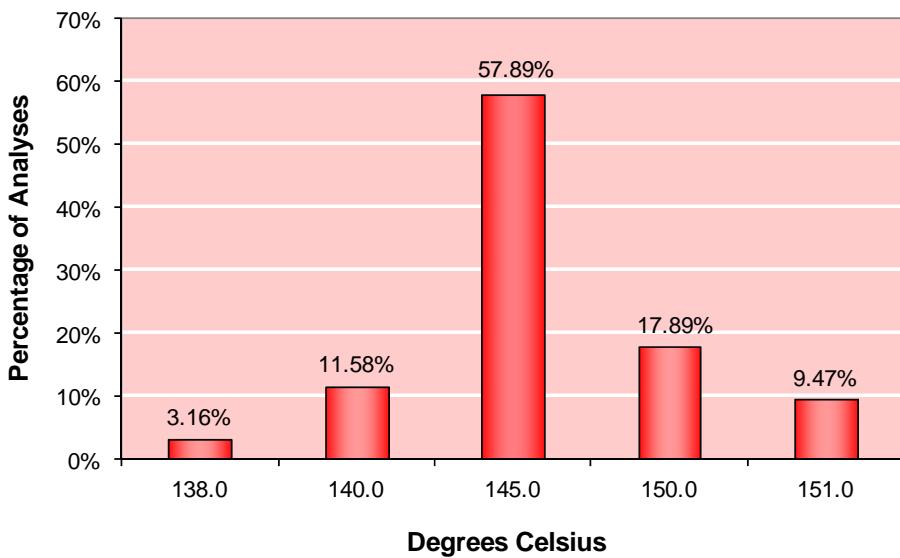
**Distillation IBP—2011**

Figure 9-2: Fractional Composition (Distillation), Temperature at Start (IBP), (°C), maximum 150

# TSI Data

## Distillation 10% Recovered—2011

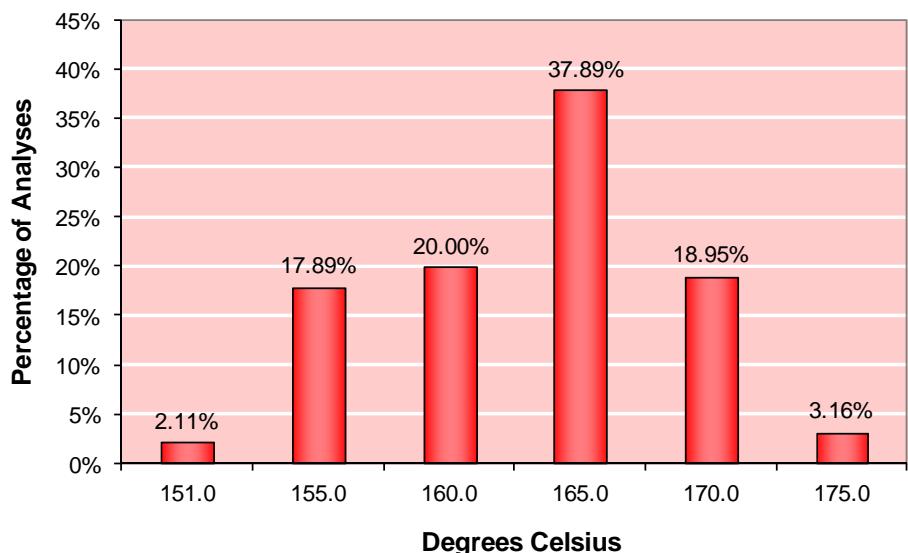


Figure 9-3: Fractional Composition (Distillation), 10% Recovered, (°C), maximum 165

## Distillation 50% Recovered—2011

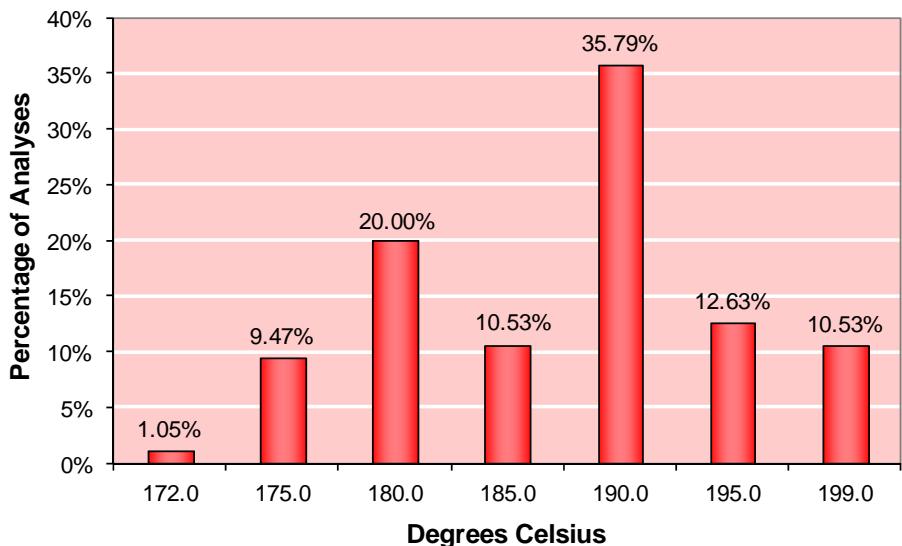


Figure 9-4: Fractional Composition (Distillation), 50% Recovered, (°C), maximum 195

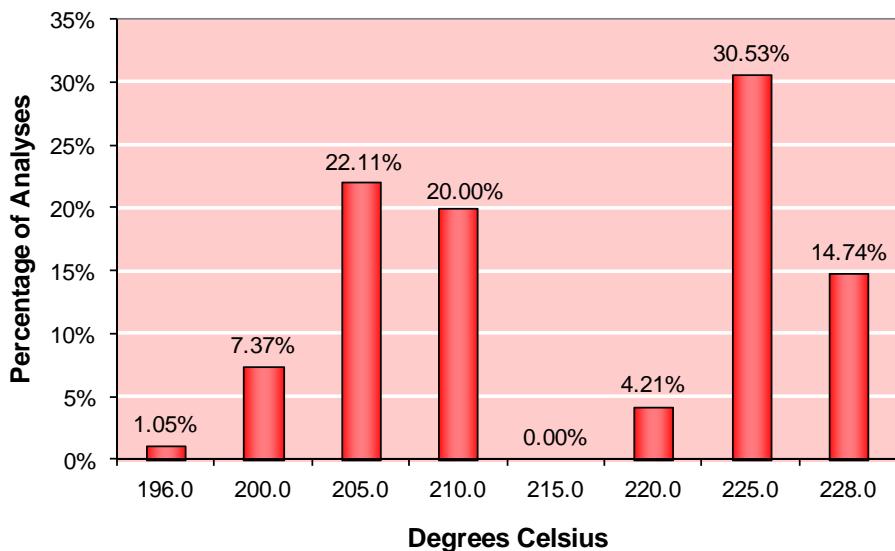
**Distillation 90% Recovered—2011**

Figure 9-5: Fractional Composition (Distillation), 90% Recovered, (°C), maximum 230

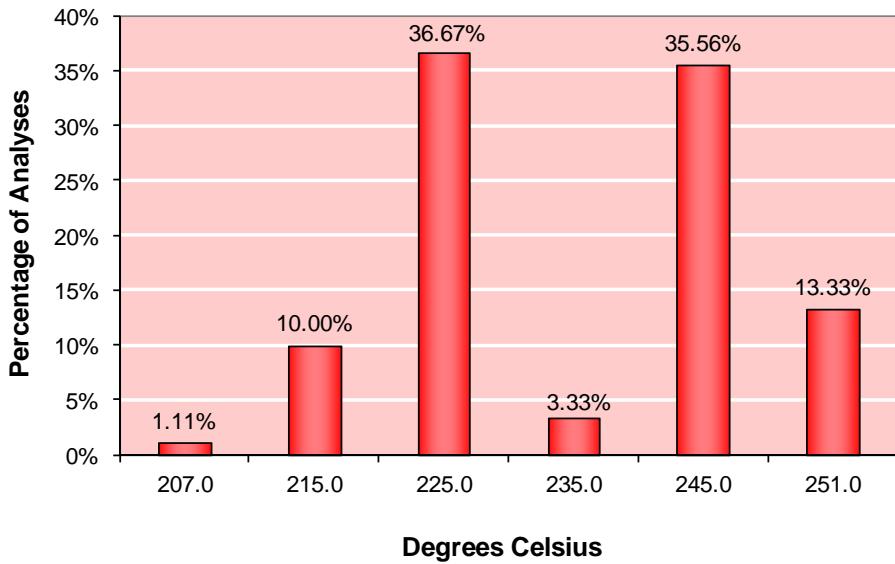
**Distillation 98% Recovered—2011**

Figure 9-6: Fractional Composition (Distillation), 98% Recovered, (°C), maximum 250

# TSI Data

## Viscosity @ 20 °C—2011

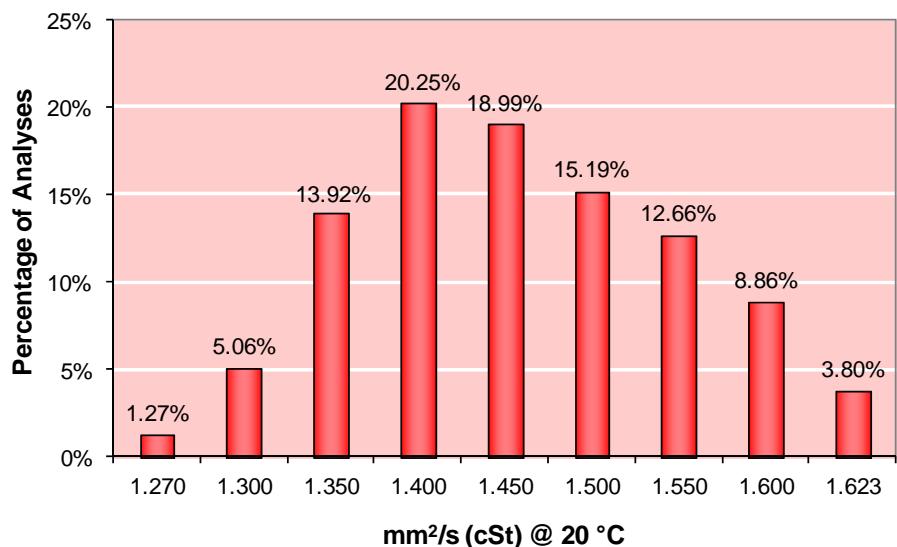


Figure 9-7: Viscosity (mm<sup>2</sup>/s (cSt) @ 20 °C), minimum 1.25

## Viscosity @ -40 °C—2011

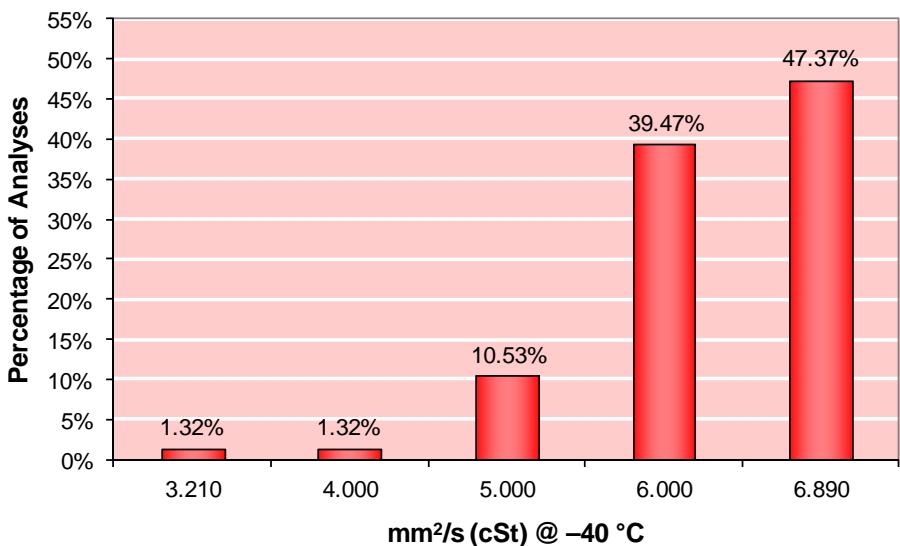


Figure 9-8: Viscosity (mm<sup>2</sup>/s (cSt) @ -40 °C), maximum 8.0

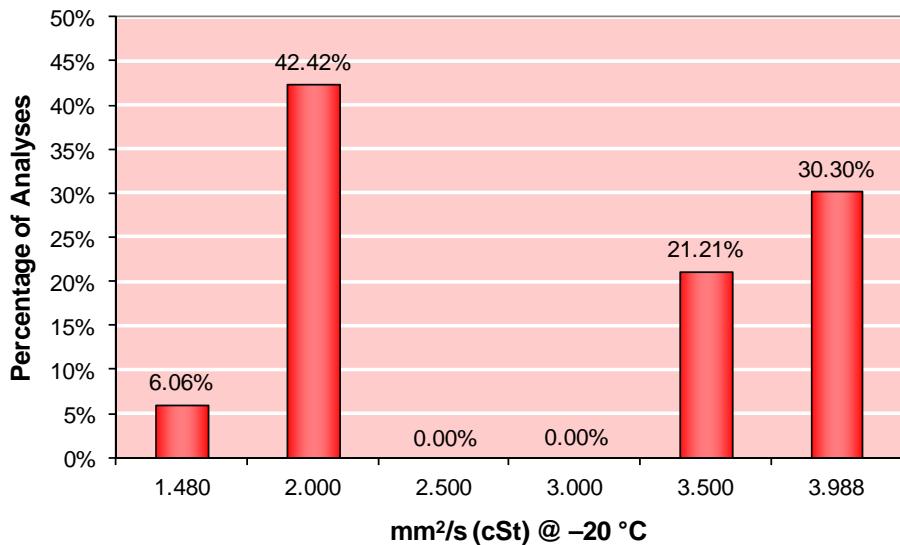
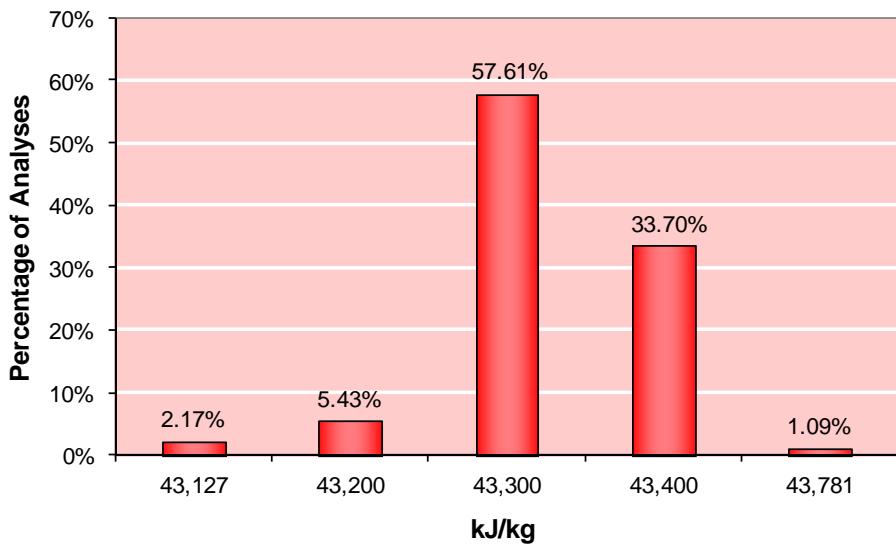
**Viscosity @ -20 °C—2011**Figure 9-9: Viscosity (mm<sup>2</sup>/s (cSt) @ -20 °C), Report**Estimate of Heat Value—2011**

Figure 9-10: Estimate of Heat Value (kJ/kg), minimum 42,900

# TSI Data

## Height of Non-Smoking Flame—2011

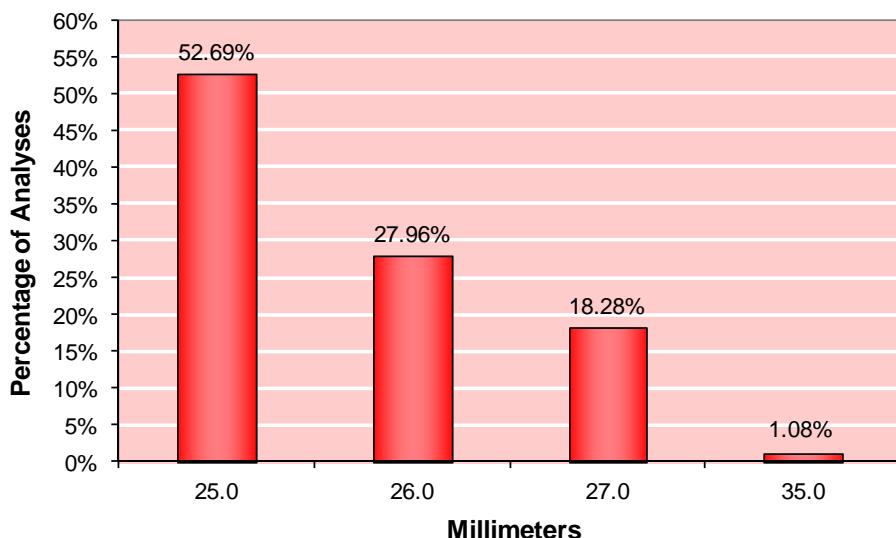


Figure 9-11: Height of Non-Smoking Flame (mm), minimum 25.0

## Acidity—2011

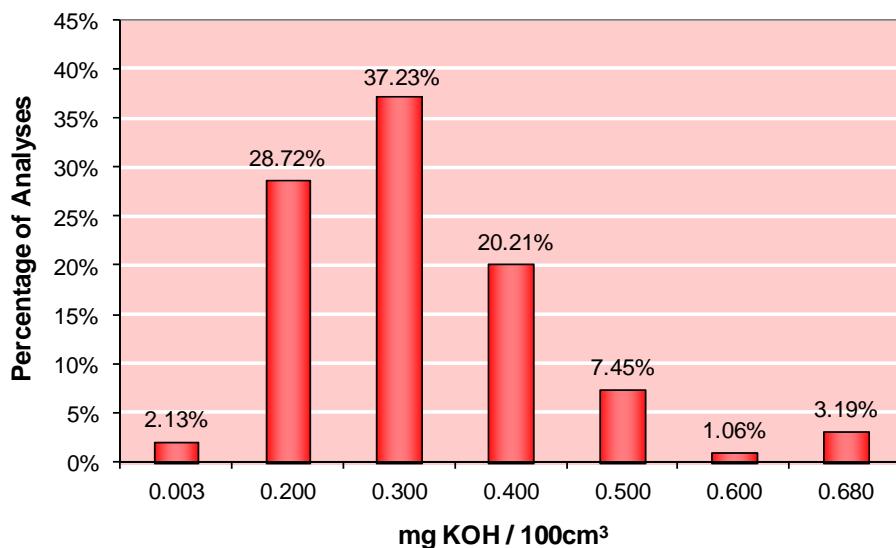


Figure 9-12: Acidity (mg KOH/100cm<sup>3</sup>), maximum 0.7

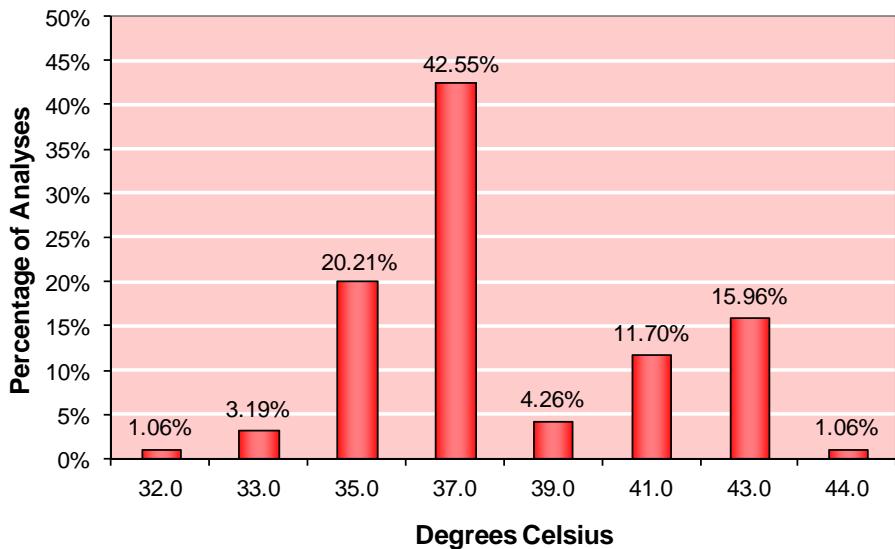
**Flash Point—2011**

Figure 9-13: Flash Point (°C), minimum 28.0

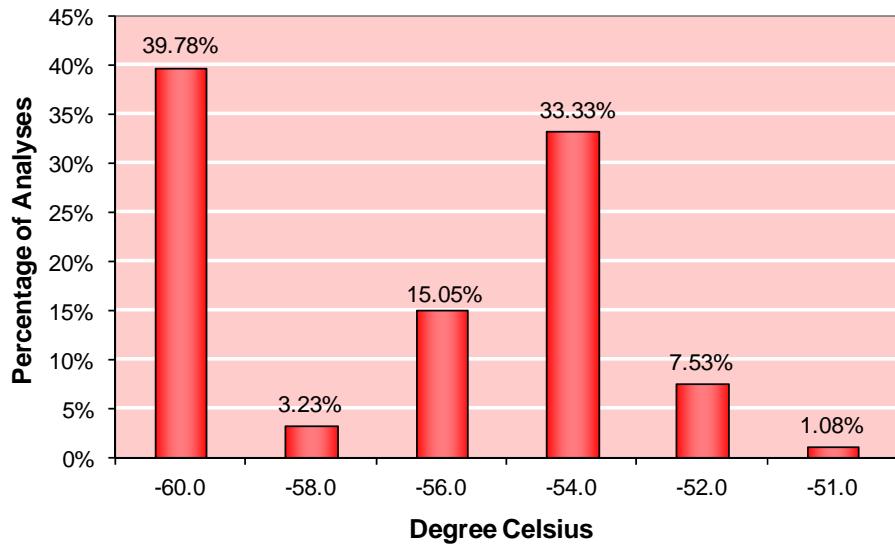
**Temperature of Crystallization—2011**

Figure 9-14: Temperature of Crystallization (°C), maximum -50

# TSI Data

## Aromatics—2011

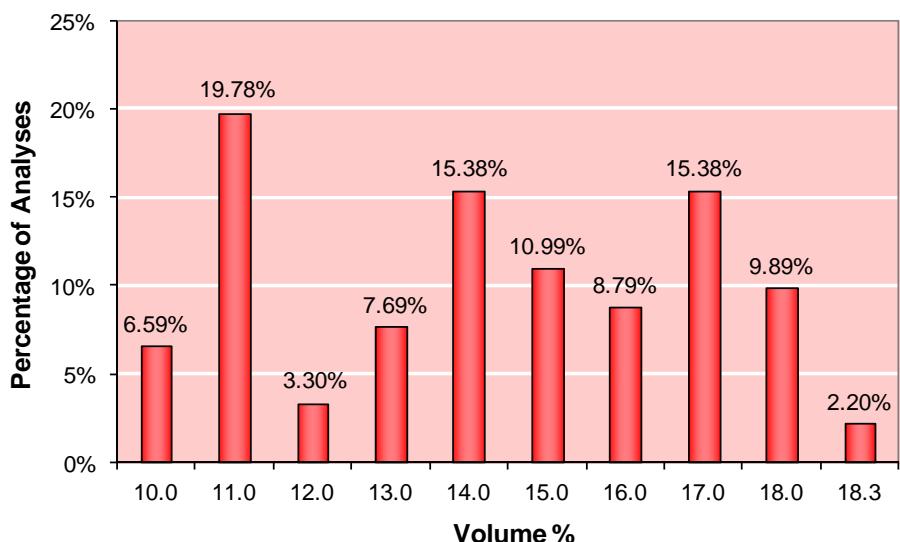


Figure 9-15: Aromatics (vol %), maximum 22.0

## Concentration of Resins—2011

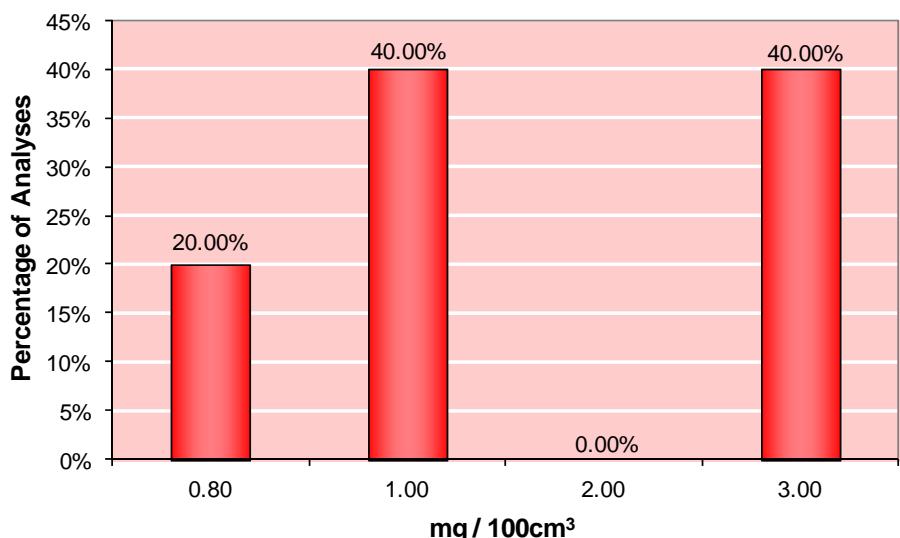


Figure 9-16: Concentration of Resins (mg/100cm<sup>3</sup>), maximum 5

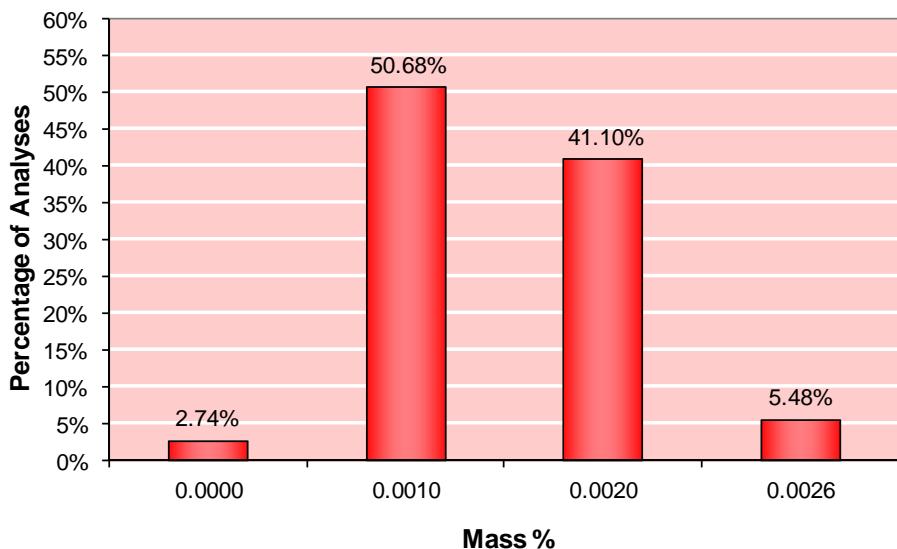
**Sulfur, Mercaptan—2011**

Figure 9-17: Sulfur, Mercaptan (mass %), maximum 0.005

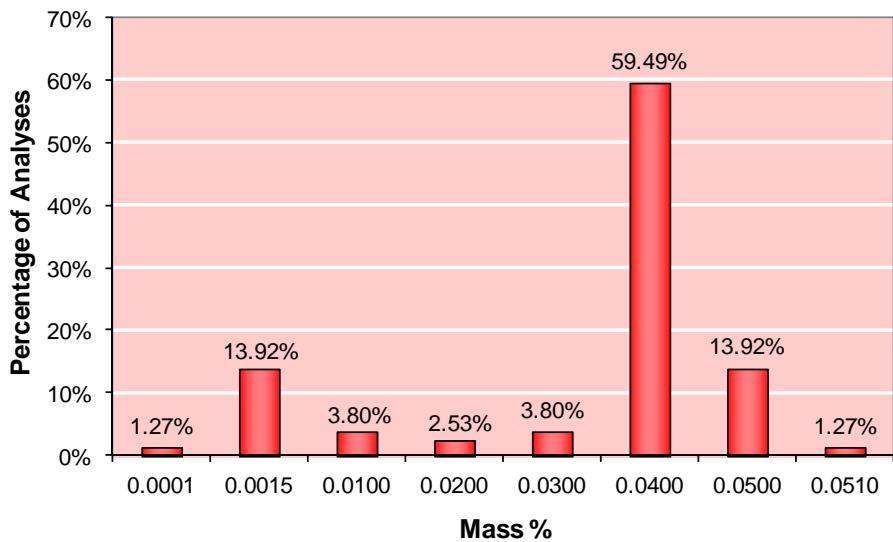
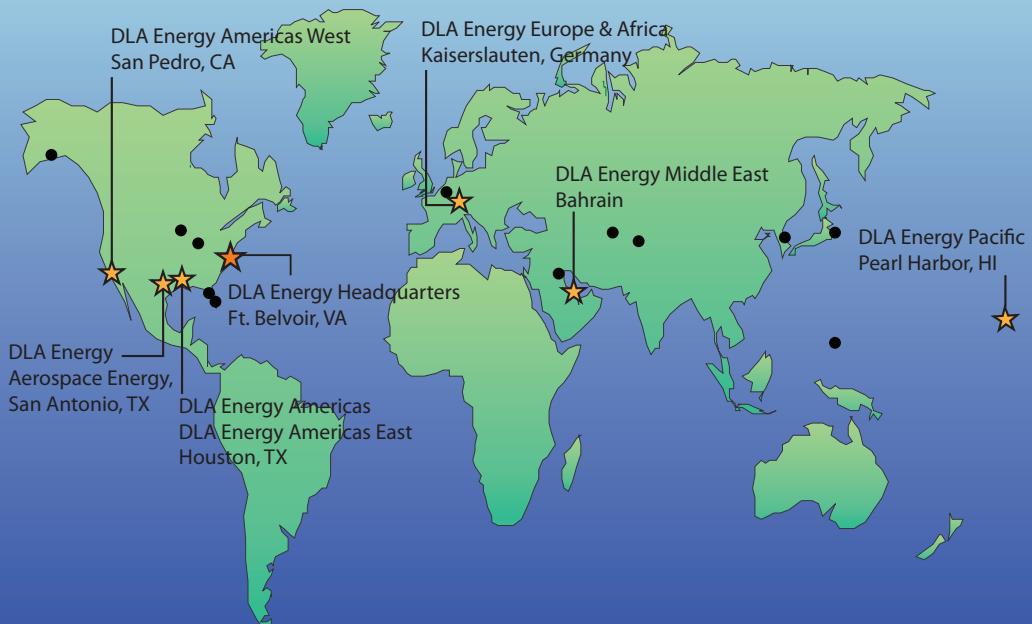
**Sulfur, Total—2011**

Figure 9-18: Sulfur, Total (mass %), maximum 0.25





## DLA ENERGY WORLDWIDE LOCATIONS



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Defense Logistics Agency Energy - DLA Energy QT  
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Tel: 703-767-8382 (DSN: 427-8382)  
DLA Energy QT email: [pqis@dla.mil](mailto:pqis@dla.mil)

All photos are courtesy of the Department of Defense.